DOCUMENT RESUME

ED 443 897 UD 033 661

TITLE	Barriers and Breakthroughs: Technology in Urban Schools. A Reporter's Guide.
INSTITUTION	Education Writers Association, Washington, DC.
SPONS AGENCY	Joyce Foundation, Chicago, IL.
ISBN	ISBN-0-943445-08-6
PUB DATE	1999-04-00
NOTE	62p.
AVAILABLE FROM	Education Writers Association, 1331 H Street, N.W., Suite 307, Washington, DC 20005 ($10); Tel: 202-637-9700; Fax: 202-637-9707; E-mail: ewa@crosslink.net; Web site: http://www.ewa.org (review copies free; $10 single copy plus $2 postage and handling).
PUB TYPE	Collected Works - General (020) -- Numerical/Quantitative Data (110)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Computer Literacy; *Computer Uses in Education; *Educational Technology; Elementary Secondary Education; Faculty Development; Internet; *Urban Schools
IDENTIFIERS	Chicago Public Schools IL; Cleveland Public Schools OH; Detroit Public Schools MI; Milwaukee Public Schools WI

ABSTRACT

This publication presents a collection of papers on technology in urban schools, focusing on efforts by the Chicago, Detroit, Cleveland, and Milwaukee school systems. Interviews with teachers, technology directors, principals, and others about their experiences using technology provide the information for these papers. The papers are: "Overview: Making Technology Work in Urban Schools" (Donna Harrington-Lueker); "Chicago: Aging Facilities, Size and Local Control Complicate Chicago's Efforts" (Susan DeGrane); "Detroit: Equity, Access and Accountability Slow Detroit's Progress" (Amber Arellano); "Cleveland: Teaching the Teachers" (Shari Sweeny); "Milwaukee: Promises of a Computer on Every Teacher's Desk and Fiber-Optic to the Door" (Priscilla Pardini); and "Tips, Resources and Sources." The first appendix is titled "Gauging Districts' Technology Plans" (Cheryl Lemke, Robert Bortnick, Gilbert Valdez, Randy Knuth, and D. William Quinn). The second appendix is titled "Sizing Up Technology Inventories." (SM)

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A REPORTER'S GUIDE

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BARRIERS AND BREAKTHROUGHS

technology in urban schools

A REPORTER'S GUIDE

EWA

We would like to thank the Joyce Foundation whose funding made this report possible. The views expressed and conclusions drawn in this report are based on the work of the reporters and the staff of the Education Writers Association and are not necessarily those of the foundation.

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Photographs by George Waldman, Detroit Journalism Photography.
Design by Cutting Edge Graphics.
Printing by Todd Allen Printing.

ISBN: 0-943445-08-6

Review copies free; 1 to 9 copies, $10 each; 10 to 24 copies, $9 each; 25+ copies, $8 each. Add $2 per copy for postage and handling. Copies may be ordered from:

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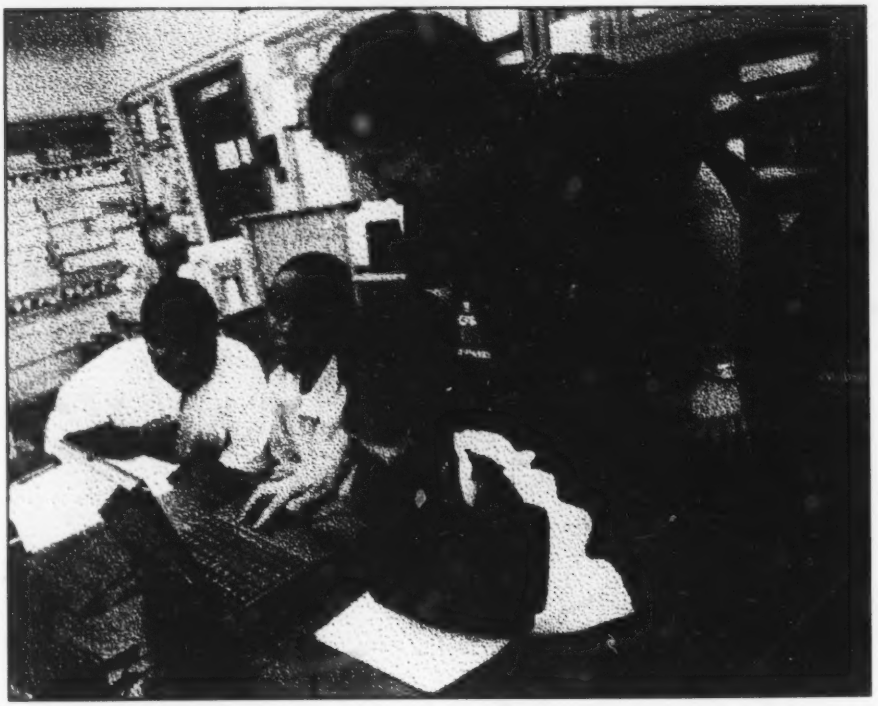

OVERVIEW

Making technology work in urban schools

By Donna Harrington-Lueker

Like other school districts in the United States, large urban school districts are familiar with the promise of computer technology. With high-speed links to the Internet, the Library of Congress is only a mouse-click away. Sophisticated multimedia programs, blending video images and sound, allow inner-city students to travel to Paris or Tokyo, Berlin or Rome. Computers link teachers with teachers, parents with schools, and students with experts around the world.

But as teachers, technology specialists, and principals in urban districts point out, that's often not the reality. Advocates talk about the ways technology can transform teaching and learning, and they point to exemplary technology programs in specific urban schools. However, such successes only underscore the problem facing most urban school districts trying to make technology work: The same factors that make any urban school reform difficult — limited resources, low expectations, overwhelming poverty, entrenched bureaucracies, political infighting, sheer size — can slow the technology revolution to a crawl.

Ironically, the school systems that advocates say have the most to gain from technology, also face the toughest obstacles.

To gauge just how tough that challenge is, the Education Writers Association (EWA) sent reporters into four large urban school districts: Chicago, Milwaukee, Detroit and Cleveland. There, reporters spoke with teachers, technology directors, principals and others about their experiences using technology, including the problems they have encountered and the successes they have had. Reporters also interviewed state and district officials, researchers, foundation officers and national experts.

Each district in the report has its successful technology programs, which the reporters have cited. In some cases, these programs involve some of the most sophisticated approaches to technology and learning being used anywhere in schools today.

But the goal of the report was to go beyond isolated pockets of excellence. We wanted to know where the districts as a whole stood with technology and why. These four districts gave us the opportunity to ask questions about the systemwide use of technology, including how technology was being used in classrooms, how teachers were being trained in the new technologies and whether schools and students had equitable access to a district's technology resources.

Finally, a panel of technology experts from the North Central Regional Educational Laboratory (NCREL) in Chicago, one of 10 federally funded research laboratories, reviewed the districts' technology plans for the report.

"A Certain Order of Magnitude"

The picture that emerges from the four cities is a complicated one. Overall, some common themes emerge, the first of which is that size does matter.

"There's just a certain order of magnitude with these large urban school districts," says Saul Rockman, a San Francisco technology consultant and former manager of education research for Apple Computer.

Most school systems have difficulty with technology — buying equipment, choosing software, training teachers, installing and maintaining high-speed telecommunications networks. The sheer enormity of these large city school systems makes the task more difficult, though, technology researchers say.

"These systems are large, and they're very loosely coupled," says Ron Marx, a professor of education at the University of Michigan at Ann Arbor and codirector of the Center for Learning Technologies in Urban Schools. Given that autonomy — and that size — it's often difficult to implement any central policy or plan, Marx says. Technology is no exception. Perhaps the only urban school district to use technology to boost achievement systemwide — the Union City, N.J., public schools, which has become a showcase for successful use of technology — enrolls only 10,000 students.

The size of individual schools can stall reform as well. Urban schools are larger than their suburban and rural counterparts, and some high schools in this study enroll between 3,000 and 5,000 students. Getting enough people involved is simply more difficult. "In a large school, you just need many more teachers to create a critical mass committed to making technology work," says Barbara Means. A researcher with the Center for Technology in Learning in Menlo Park, Calif., Means is working with several Chicago high schools.

Another complication of size: Many technology researchers talk about the importance of making technology part of a school system's overall plan for improved achievement. But large urban school systems typically have divided

SHORTFALLS IN URBAN SCHOOLS

A majority of schools in the central city report that they lack six or more basic technology elements such as networks, modems, or phone lines in instructional areas. Such shortfalls, shown as a percentage below, affect a school's ability to use technology well.

TECHNOLOGY ELEMENT	CENTRAL CITY (%)	URBAN FRINGE/ LARGE TOWN (%)	RURAL/ SMALL TOWN (%)
Fiber optic cable	90.2	87.8	84.4
Conduits	66.9	61.9	55.6
Phone lines in instructional areas	66.8	60.6	57.8
Modems	65.0	55.9	53.5
Networks	60.9	50.6	46.5
Phone lines for modems	61.3	55.3	51.8
Electrical wiring for communications technology	54.8	46.7	40.1
Electric power for communications technology	42.9	36.9	27.8
Laser disk player/VCRs	38.7	32.2	30.9
Printers	38.1	26.7	25.2
Cable TV	33.0	32.8	30.0
Computers	31.7	24.5	21.2
TVs	18.6	17.1	13.3
Six or more unsatisfactory technology elements	60.0	52.0	46.5

Note: Sampling error range+/- 1.7-3.5 percent
SOURCE: U.S. General Accounting Office, *School Facilities: America's Schools Not Designed or Equipped for 21st Century*, April 1995

technology into two separate camps: information management — which includes payroll and personnel, finance and record-keeping — and curriculum. Because these districts tend to be much larger bureaucracies, with more layers of administration, it's often difficult to develop the connections between the two camps that are needed, technology advocates say.

Networking issues can be particularly thorny when information management and curriculum are at odds. Marx cites the case of a Detroit school that needed to use a Web-based application for its technology program but couldn't access the application because of a firewall the district had installed to protect its administrative systems. Another school found it could no longer send information to the central office after the district upgraded its network connection from a 56KB to a T1 line, which can carry more data more quickly.

Glitches like these happen in any school system. In urban school systems, with large numbers of schools, shaky channels of communication and little technical support, such problems are "writ large," Marx says.

So are problems with school buildings. High-speed computer networks are the future of educational technology. But urban school systems have large numbers of aging buildings, and outfitting these buildings with the raceways needed for telecommunications lines or upgrading electrical lines will take billions of dollars. According to a districtwide inventory in Chicago, almost half of the city's 550-plus schools are more than 50 years old, and 11 percent, built as temporary facilities during the 1960s, have outlived their estimated 20-year life span. Another 9 percent of Chicago's schools top the 100-year mark.

Those facilities amount to roughly 70 percent of the district's schools, and updating them to accommodate computers and telecommunications networks could cost as much as $2 billion, according to district estimates. One Chicago elementary school anticipates costs of more than $325,000 for wiring, asbestos abatement and electrical upgrades, the Chicago Panel on School Policy reported this past summer. In some of the city's high schools, those numbers could reach $3 million for a single building, a district official says.

Other urban school systems face similar costs. "You're talking about a cumulative impact," says Linda Roberts, director of technology programs for the U.S. Department of Education. "When you let things go for . . . years, everything needs to be fixed."

As a 1995 report from the General Accounting Office (GAO) suggests, as many as 60 percent of inner-city schools do not have sufficient phone lines, modems, networks, conduits and other basic building elements needed to support technology.

Finally, advocates point out, all four school systems in this study serve enormous numbers of students living in poverty. In Detroit and Chicago, 85 percent of students are eligible for free- and reduced-price lunch, a standard measure of child poverty. In Milwaukee, the figure is 80 percent; in Cleveland, 75 percent. These urban pockets in the nation's Rust Belt have levels of

poverty so concentrated that sociologists dealing with such cities distinguish between the urban poor and the urban ultra-poor.

"We're talking about pervasive and structural poverty," says Marx. "Schools have to deal with it and the ways it's manifested in schools."

For many, the mathematics are inescapable: A reform with a large initial capital investment and substantial ongoing cost for maintenance and teacher training isn't going to be easy.

"Face it," says Elliot Soloway, a University of Michigan researcher working in Detroit. "Without money, nobody does technology."

Sizing Up the Digital Divide

In fact, equity remains an issue for urban schools. Over the last decade, schools nationwide have made enormous gains in acquiring technology, adding Internet access and multimedia computers to their technology base. Illinois, Wisconsin, Michigan, and Ohio all rank above the national average on such measures.

At the same time, federal and state technology funds targeted at high-poverty school districts have helped large urban school systems keep pace, narrowing the so-called "digital divide" between rich and poor school districts.

But while the gap has narrowed, it hasn't disappeared. Nationwide, the ratio of students to computers was 8:1 in 1996–97, according to Quality Education Data (QED), a market-research firm that tracks such numbers. That year, the latest for which figures are available, all four districts in this study had ratios higher than that average, with ratios in Chicago (16:1) and Cleveland (15:1) double the national rate. In Detroit, the ratio was 13:1 in 1996–97; in Milwaukee, 10:1, according to QED. At the same time, though, these ratios are likely to include large numbers of outdated computers that aren't powerful enough to run sophisticated software, play CD-ROMs, or even connect to the Internet. According to QED data for 1996–97, more than three-quarters of Detroit's

MULTIMEDIA COMPUTER INTENSITY, state by state

State	Students Per Multimedia Computer
Kansas	8.9
Nebraska	9.7
Ohio*	9.8
Wyoming	10.3
Alaska	10.4
Iowa	10.7
Missouri	10.8
Delaware	11.3
Indiana	11.5
Michigan*	11.5
Idaho	11.5
New Jersey	11.7
South Dakota	11.8
North Dakota	11.9
Wisconsin*	11.9
Texas	11.9
Minnesota	12.0
Florida	12.0
South Carolina	12.2
Virginia	12.4
Pennsylvania	12.5
Oklahoma	12.6
Illinois*	12.8
Massachusetts	12.9
Colorado	13.2
NATIONAL AVERAGE	13.5

State	Students Per Multimedia Computer
Georgia	13.8
Oregon	13.8
Arkansas	13.9
Montana	13.9
New Mexico	14.1
New York	14.2
Arizona	14.4
Maine	14.5
Vermont	14.5
Hawaii	14.5
Tennessee	14.6
Connecticut	14.8
Washington	15.0
West Virginia	15.4
Maryland	15.8
Mississippi	16.0
Kentucky	16.2
North Carolina	16.7
Nevada	16.7
Alabama	17.1
Rhode Island	17.1
New Hampshire	18.1
California	18.4
Louisiana	18.4
Utah	21.3
District of Columbia	28.0

SOURCE: Market Data Retrieval, *Technology in Education*, 1998

* Featured in this report.

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INTERNET ACCESS, state by state

State	Students per Computer with Internet Access
Iowa	6.0
Nebraska	8.2
Alaska	8.8
Delaware	11.1
Maine	11.8
Washington	12.7
Minnesota	12.7
South Dakota	13.1
Idaho	13.2
Utah	13.6
Oregon	13.9
Wyoming	13.9
Indiana	14.2
North Dakota	14.4
Kentucky	14.5
Hawaii	14.8
Colorado	15.0
Ohio*	15.0
Missouri	15.1
Michigan*	15.5
South Carolina	15.8
Arkansas	17.0
Illinois*	17.2
Vermont	17.2
West Virginia	17.2
Arizona	17.3
Wisconsin*	17.4
NATIONAL AVERAGE	**19.7**
Virginia	19.8
Texas	20.8
Oklahoma	20.9
Maryland	21.9
Rhode Island	21.9
Montana	22.5
Florida	23.1
California	23.8
Tennessee	24.3
Nevada	24.5
New Mexico	25.1
Kansas	25.6
New York	26.9
Mississippi	27.0
Massachusetts	27.9
New Jersey	28.6
Pennsylvania	28.6
Georgia	34.5
New Hampshire	36.8
Connecticut	38.2
North Carolina	46.1
Louisiana	48.5
Alabama	60.5
District of Columbia	66.7

SOURCE: Market Data Retrieval, *Technology in Education*, 1998

* Featured in this report.

14,000 computers were likely to have been older models, such as Apple IIes and 286 PCs, as were nearly half the computers in Chicago, Milwaukee, and Cleveland.

More recent figures from Chicago's technology inventory are consistent with those numbers, showing that only about half of its 42,272 computers (56.4 percent) were powerful enough to run so-called tool-based software, such as spreadsheet and data-base programs, or support an Internet connection. The rest were Apple IIes, Macintosh LCIIs, or 286 PCs — dinosaurs given current software and Internet requirements.

Similar trends exist in other districts identified by the Council of the Great City Schools as being comparable in size with the districts in this study. The only exceptions: Districts with lower poverty rates (such as Clark County, Nev.) or districts in states with significant technology initiatives (such as Louisville, Ky., or Dade County, Fla.) have markedly better student-to-computer ratios. (See Appendix 2: Sizing Up Technology Inventories on page 53.)

Reporters also found that the most severe inequities were likely to exist within a district's own schools. Cleveland's elementary schools have approximately one computer for every eight students, due largely to the state's SchoolNet Plus program, which provided computers for every kindergarten through fourth-grade classroom.

At the high school level, though, there is one computer for every 209 students in the classroom and one for every 47 students in a laboratory. Middle schools also fall short with one computer for every 1,140 students in the classroom and one for every 27 students in the computer labs.

According to a 1997 technology survey in Detroit, some schools reported having no technology — no computers, no fax machines, no televisions, no VCRs — while others had computers in every classroom.

One reason for such inequities: Reporters found that a school's computer capacity depended heavily on the presence of a savvy principal or a group

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of entrepreneurial teachers who were skilled at writing grants, building partnerships and obtaining additional resources for the school. Partnerships with outside organizations — universities or local corporations — also were important to a school's success.

Internet Access

Reporters also found that all four districts had significant gains to make in Internet access and networking — and that all four were poised to do so with E-rate funds.

Overall, schools have made significant progress getting on-line. According to figures from the National Center for Education Statistics, only 35 percent of public schools reported having Internet access in 1994. Four years later, that number rose to 89 percent. The nation's poorest schools — schools in which more than 70 percent of students qualify for free- or reduced-price lunch — have made similar gains. In 1994, only 19 percent of these schools had Internet access compared with 80 percent in 1998.

Schools serving large numbers of poor children remain far less likely to have their classrooms connected to the Internet. In 1998, only 39 percent of classrooms in high-poverty schools had Internet access vs. 62 percent of classrooms in the most affluent schools.

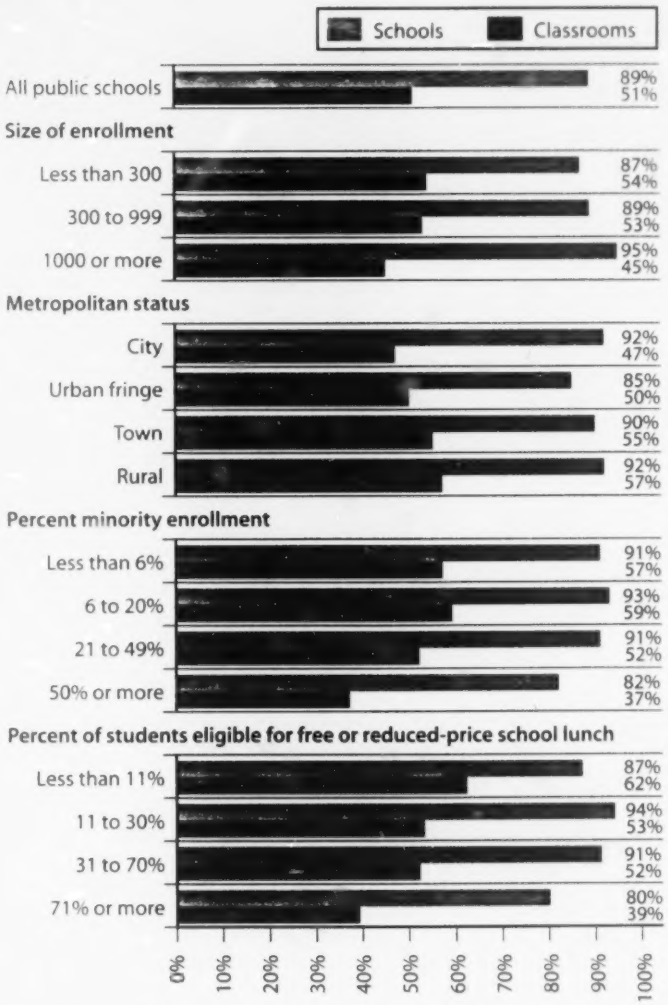
Paul Karlin, director of technology for the Cleveland Public Schools, is especially aware of the gap. Last fall, only two of the district's 118 schools were connected to the Internet, and only 300 of its 3,369 classrooms had access. Karlin expects those numbers to change dramatically when the district receives the $28 million in E-rate funds it has requested and begins installing T1 lines to every school this year. "All of a sudden we're going to go from nothing to armies of technicians invading schools," Karlin says.

Almost half of Milwaukee's schools already have Internet access via high-speed T1 lines, which the district plans to replace with fiber-optic cable when it receives its first wave of E-rate funds. (The district received $23.4 million.) At the same time, though, only 1,000 of its 5,000 classrooms have Internet access. Detroit and Chicago have both embarked on ambitious plans to provide T1 lines to all or many of their schools. But the lines may only go to the schoolhouse door. Less clear is where the funding will come to wire classrooms to the wide-area network, especially in Chicago.

Urban schools are also less likely to have high-speed access to the Internet. Specifically, high-poverty schools are half as likely to have broadband Internet access as other schools, says Ron Anderson, a professor of sociology at the University of Minnesota and a coinvestigator of Teaching, Learning, and Computing 1998, a national survey of 4,000 teachers, principals and technology directors.

Nearly 35 percent of high-income schools have access to a T1 line or faster, while only 20 percent of high-poverty schools have such access, the study found.

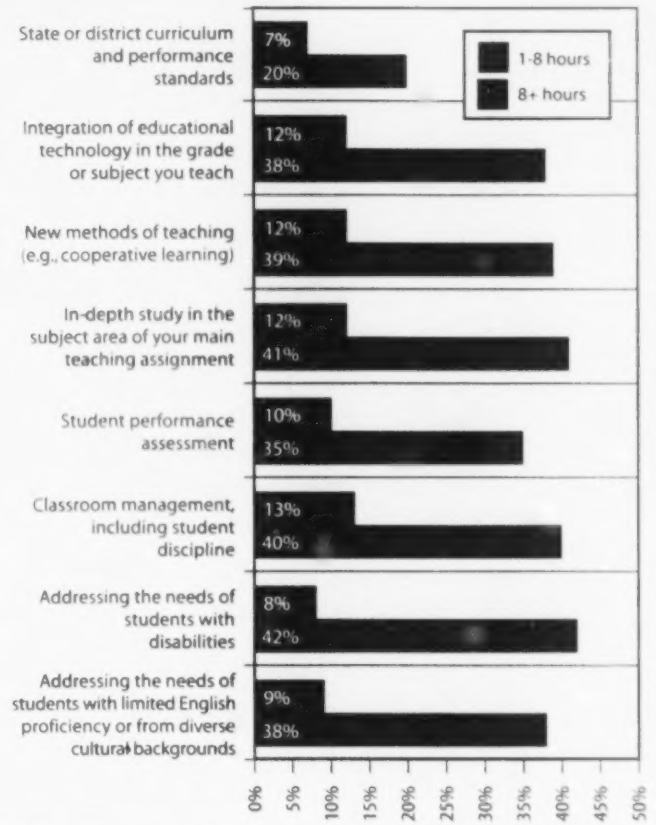
SCHOOLS vs. CLASSROOMS CONNECTED TO THE INTERNET, 1998



SOURCE: U.S. Department of Education, National Center for Education Statistics

EFFECTS OF TECHNOLOGY TRAINING ON TEACHING, 1998

Percent of full-time public school teachers who participated in professional development activities in the last 12 months indicating the extent to which they believe the activity improved their teaching substantially.



SOURCE: U.S. Department of Education, National Center for Education Statistics

Recognizing the Practical Barriers

Ultimately, why does technology take root in some schools and not others? What keeps a district from making headway? Reporters repeatedly found that everyday practical barriers were among the most serious threats, their sheer cumulative weight conspiring to bring progress to a standstill.

Technology, for example, is a teacher-intensive reform requiring a long-term commitment to mastering hardware, software and new ways of teaching. Urban schools, though, have high turnover rates among their teaching forces. One-third of urban teachers leave their districts in their first four years on the job, says Rockman, many of them moving to better-paying suburban systems.

This past year alone the Detroit Public Schools had more than a thousand vacancies on its teaching staff. "Teachers figure out how to teach and then move on," says Margaret Riel, associate director of the Center for Collaborative Research in Education at the University of California at Irvine and a specialist in school technology. "It makes it very difficult to have a coherent technology program." In urban schools, too, new teachers who might have some technology experience also spend much of their time learning to manage classroom discipline rather than working with technology, Riel and others say.

"We found that it takes three years for a teacher to learn to do this kind of teaching [with technology]," says Marx. "But we also found that once you train someone to do it, they go to Bloomfield Hills [an affluent suburb of Detroit], and we have to start all over again."

Providing technology professional development is also difficult. Chicago has a team of 26 teacher trainers serving more than 550 schools. Detroit has moved responsibility for technology training to the school level, yet many schools report they have neither the funds nor the in-house expertise to provide such training on their own. Cleveland must provide 60 hours of training for every elementary school teacher in the next three years, but the department providing that training has only eight full-time teacher trainers.

Yet training teachers to use technology effectively is critical, technology researchers say. "The biggest challenge in urban schools is that teachers and schools lack the vision of what to do with technology," says Nora Sabelli, senior program director for the National Science Foundation's Urban Systemic Initiative.

Lack of central support for repairing and maintaining computers and networks also plagues the schools in the study. Chicago has a central team of six technicians who help schools with maintenance and repair. But every technician services 93 schools. While schools can contract for repair services on their own, many often let the problem go unsolved. In Soloway's words, in urban schools, if a computer breaks, it's gone.

Means is struck by the irony of the situation: Large urban districts are often more likely than other school systems to have certain resources, at least on paper — resources like teams of teacher trainers or computer technicians. Given the number of teachers and schools to be served, though, such resources become "a drop in the bucket compared to the need," says Means.

Further, while technology advocates urge teachers to use technology to

do research or work on sophisticated projects, a significant number of low-performing schools in these districts continue to work with drill-and-practice programs, computerized reading comprehension tests or networked integrated learning systems (ILSs) that emphasize discrete skills. The reason: Faced with high-stakes standardized tests and the threat of reconstitution, many low-performing schools want assurances that technology will help them improve test scores.

Bruce Goldberg, head of Co-NECT Schools, one of the New American Schools Development Corp.'s technology-intensive school designs, is familiar with that pressure. "Teachers know they'll be held accountable for test scores," says Goldberg. "If it can't be shown that the computer can in fact raise scores, they're not that interested."

Low expectations for children who live in poverty also play a part. "A lot of research shows that in low-income schools there's a strong belief in focusing on basic skills first. Anything else is a luxury," says Means. "So the view of many teachers [toward technology] is, 'Well, that's nice. If they ever pass the state competency test, we'll do that.'"

Those expectations become a self-fulfilling prophecy, says Means: Since poor and minority children aren't expected to do well with sophisticated tasks, they are often given drill-and-practice instead.

Everyday Obstacles

Day-to-day problems are equally vexing. Faced with a number of thefts from its classrooms, a Detroit school moved its computers to its second floor. But in doing so, it created another problem: Every day teachers would have to take their students upstairs to use the equipment, a trek that could take 20 minutes roundtrip with the youngest students — a real issue for an elementary school teacher, Soloway says.

Another school in the district wanted to outfit 20 homes with set-top boxes — hardware that turns a television set into a computer — so that students could work on projects at home and send their results to school over the Internet. Four families didn't have a telephone line to support the Internet connection.

Broadband connections that will carry voice and video as well as data haven't always been available in high-poverty neighborhoods either. As of January 1999, two of the 10 Detroit schools working with the Center for Learning Technologies in Urban Schools had been unable to get T1 access because the telecommunications company didn't provide that service to the neighborhood, Marx said.

In Chicago, some schools are so strapped for space they don't have room for a network router, and in all schools principals find themselves overseeing the complexities of bidding out and installing telecommunications networks in their schools. In Milwaukee, teachers balk at after-school and evening technology training sessions.

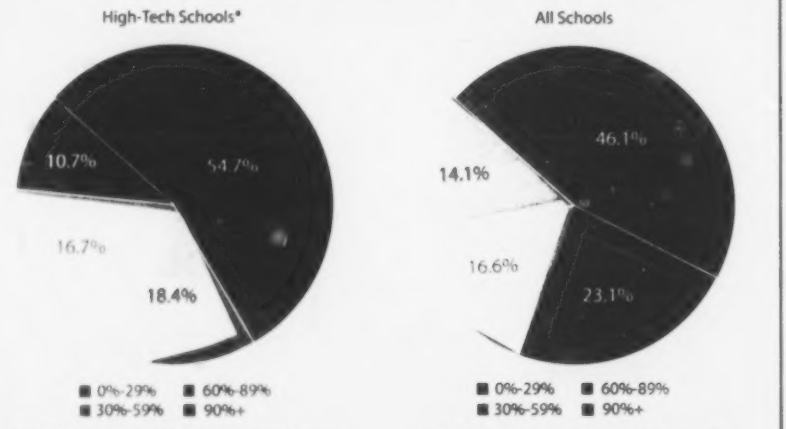
And in all districts deciding how to distribute limited technology resources often pits pedagogy against politics. Should the Internet connections be installed at the high school first or the elementary school? Should the 25 new computers go in a single lab where all students can use them or should they be divvied up one or two to a classroom?

In the interests of equity, districts are often compelled to distribute technology evenly, even though that might mean putting just a single computer in a classroom. Sometimes, though, putting a sufficient number of computers in a computer lab or media center would do more to improve access.

Slowly, the school systems in this report are putting technology in place. Both Chicago and Detroit are attempting to embed technology in their academic programs in a systematic way, says Louis Gomez, a professor of education at Northwestern University and codirector, with Marx, of the Center for Learning Technologies in Urban Schools. Cleveland and Milwaukee are on the same path.

The chapters that follow chronicle those efforts.

SCHOOLS BY PERCENTAGE OF TEACHERS USING COMPUTERS DAILY



Should be read as: In 54.7% of the hi-tech schools, 90% or more of the teachers are using computers daily.

Should be read as: In 23.1% of all the schools, 90% or more of the teachers are using computers daily.

*High-tech schools have better than the national average ratio of students to computers and to CD-ROM drives as well as network and Internet access.

SOURCE: Market Data Retrieval, *Technology in Education*, 1998

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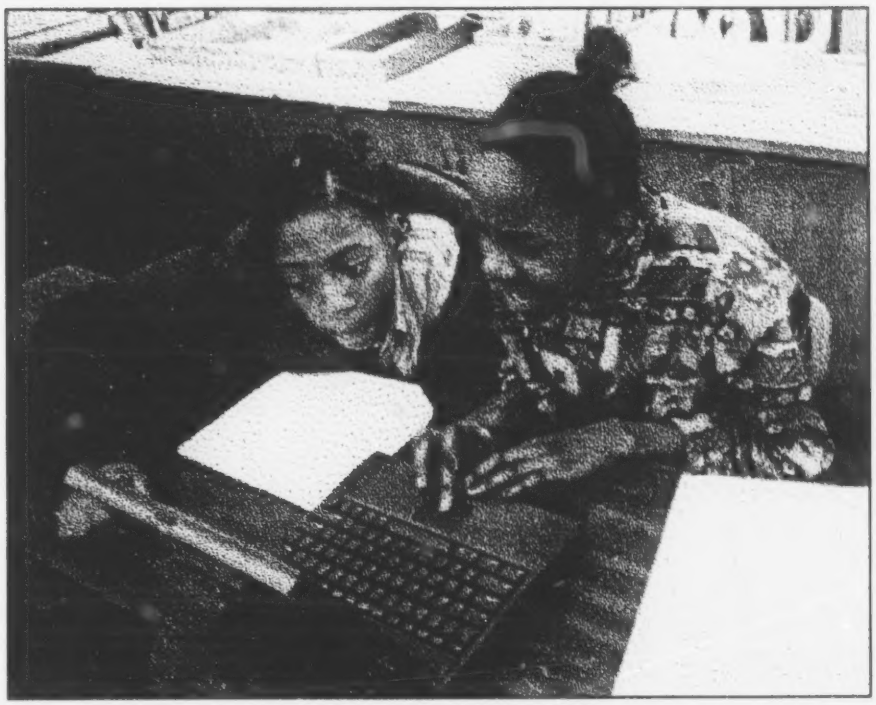

❶ CHICAGO

Aging facilities, size and local control complicate Chicago's efforts

By Susan DeGrane

When Rita Gardner took the helm as principal of Chicago's James Shields Elementary School in 1991 and conducted her first classroom observation, she discovered that the delivery of instruction hadn't changed much in the 14 years since she had last taught there.

"I was sitting next to a little boy who had a whole world going on in his desk with spacemen and stick figures and action heroes," remembers the principal of this neighborhood school which serves 1,666 students on Chicago's southwest side. "It occurred to me the world had changed, and the students had changed with video games and Nintendo, but education just wasn't keeping up. Nor were we preparing students with skills for real life."

Gardner had spent several years as a career counselor at Chicago Vocational High School where, she says, she had the opportunity to watch technology make many jobs obsolete. "The entire print shop department was phased out," Gardner says. "Now, there's not a trade around that does not use a computer in some capacity."

Gardner shared her observations with the faculty at Shields and soon the school and its staff were committed to finding out all they could about the use of technology in teaching. They visited other schools, both within the district and outside it, and they attended conferences. Six teachers that Gardner selected to spearhead the transition received training from IBM, both off-site and during school hours; after the training, they became mentors to other teachers. In Gardner's words, the school focused on teaching students how to think critically rather than simply learn to operate computers.

"We started small, partially due to financial constraints, but it worked well because it wasn't as upsetting to the existing order as trying to change over the whole school at once," Gardner says.

Since that time, students in all grades have come to use computers in core subjects. With six computers in each classroom and several learning labs, the school has a total of 362 PCs that vary greatly in capacity and age, but remain compatible and interconnected. Having compatible technology that would support collaboration among teachers was a priority at the school, Gardner says.

While the school does not yet use the Internet, it is fully prepared to do so when the Chicago board of education supplies T1 lines for connectivity, slated for March or April of 1999.

A pivotal issue within CPS in recent years has been balancing the need to align the district's curriculum with state and city standards with the need to modernize instruction to include technology. While some schools suggest the dual objective is problematic, it has not been an issue at Shields.

CHICAGO PUBLIC SCHOOLS

Number of schools	589
Total enrollment	430,208
Demographics	
African American	53.7 %
Latino	32.6 %
White	10.3 %
Asian/Pacific Islanders	3.2 %
American Indian	0.2 %
Free and reduced lunch	84.5 %

SOURCE: Chicago Public Schools

"The implementation of technology as well as collaboration among teachers revitalized the learning environment here," Gardner says. "I think it strengthened us for changes that might have upset the performance of schools less committed to renovating their approach to teaching."

A Steady, But Not Rapid, Pace

Shields Elementary School remains an exception in Chicago. Overall, technology is making its way through the Chicago Public Schools with the resolve, yet the pace of a glacier. In the nation's third-largest school system, change may be steady, but it's rarely rapid.

That change is also taking place against a backdrop of extensive systemwide reform. Frustrated with chronically low levels of achievement in the district, the Illinois Legislature a decade ago passed an ambitious school

reform bill transferring school governance from a recalcitrant board of education to local school councils. Eight years later, the Legislature shifted governance again and granted broad powers to Mayor Richard Daley.

Though the changes have been controversial, the system has shown progress in righting itself. A $35 million plan to boost academic achievement has resulted in a districtwide curriculum that emphasizes high standards and mandatory summer school for students who have fallen behind. Schools once consigned to the state's watch list for chronically poor achievement have worked their way off. For the last three years, too, standardized test scores have improved, outpacing improvement in other districts in the state.

The overall reform effort has included revamping teaching and administrative practices, renovating old facilities and building new ones, cutting fat from the system and balancing the district's mismanaged budget.

At the same time, though, the district has grown considerably, adding 24,000 students in the last five years. With approximately 430,000 students, the district has watched its number of schools rise from 544 to 589.

Partly because of these increases, the district has devoted major funding to a capital improvement plan, now in its third year. Specifically, by fall 1998, the district had completed or begun construction on $1.14 billion in new construction and renovation projects: eight new schools, 21 additions, 27 annexes and 1,277 renovation projects. Another $600 million was allotted for additional projects.

But while the investment is intensive, the system remains strapped. Overcrowding and disrepair continue to plague the district. At school board meetings, pleas for school expansions are common, with parents complaining of class sizes of 38 students and lessons being taught in hallways, on auditorium stages or in washrooms and coatrooms.

When two parents approached board members at a public meeting last fall and complained that their child had to eat lunch at his desk, school board president Gery Chico fired back, "My kid eats at his desk. Many students in this system eat at their desks."

The extreme and extenuating needs of the district are a factor as well. Chicago spends about $7,102 per pupil, slightly less than the amount spent in suburban Cook County, but a good deal more than the $5,917 average for the state.

The difference lies in the high percentage of low-income and limited English proficient students who have greater educational and support needs and who require substantial additional resources to serve. Low-income students account for 84.5 percent of Chicago's enrollment compared with 22.1 percent for the remainder of the state. Limited English students account for 16.2 percent of enrollment; in the rest of the state that figure is 3.7 percent.

In recent years as well the district has placed tremendous emphasis on improving standardized test scores. Schools in which less than 15 percent of students score at national norms have been placed on probation, then reconstituted and restaffed. The state and city are working to ensure that the district aligns its curriculum with their standards, and that teachers and administrative staff are held accountable.

Technology and Local Control

Chicago's school reform movement has also provided schools with significant autonomy, especially over program and budget. Each local school council selects its own principal, oversees the budget and has input into both the school improvement plan and the curriculum. Consequently, each school operates independently, much like its own school district.

While this arrangement has led to tremendous innovation in some schools, its effect on a school's ability to incorporate technology into instruction has been mixed. The district's most rapidly moving and resourceful schools have put together showcase technology programs. A district brochure highlights 13 schools as technology development sites.

One of these schools, the Helen C. Peirce School of International Studies on Chicago's northwest side, serves an extremely diverse student enrollment with children who attend the school speaking 20 different languages. In addition to using computers to enhance mathematics, reading, social studies and science, the school was selected for Project Net Across the Sea and maintains a relationship with a school in Birmingham, England, via the Internet. Another school — the Chicago High School for the Agricultural Sciences — makes special use of computer technology and Internet research for science fair projects and agribusiness classes.

The advantage: Local control allows schools to develop their own programs and to move forward when they're ready. Because schools receive state anti-poverty funds for each low-income child they enroll, a number of schools have made headway because they've had a significant funding stream of their own. Shields, for example, received $1.1 million in state anti-poverty funds in 1998–99.

That flexibility — that autonomy — could be key. Barbara Means, a researcher with the Center for Technology in Learning who is working with several Chicago high schools, acknowledges that a centralized school system offers advantages, including economies of scale. But "cookie-cutter solutions" to technology can "leave schools feeling disenfranchised," Means says. Providing schools with the opportunity to develop their own technology programs, consistent with their achievement goals, is important.

Louis Gomez, a professor at Northwestern University and a codirector of the Center for Learning Technologies in Urban Schools, also sees the value of local control. Most schools, Gomez says, have just begun to talk about how they'll use technology. And to be successful, they'll have to think seriously about what technology means to them and how they'll use it

effectively. The answers will be different for every school, no matter what the district, Gomez says.

Still, many Chicago schools have struggled to obtain funding and secure equipment. Overall, the work of establishing technology programs in individual schools reveals slow progress and tremendous duplication of effort.

Some argue, too, that the reliance on local school councils relieves the central board of education from having to go to bat for all 589 schools and forces too many schools to vie for the same limited resources. The result: The success of a school's technology program often depends almost entirely on a school's principal, its local school council or its technology coordinator or librarian, who put in countless hours negotiating with the board as well as with state and federal bureaucracies.

"What you see systemwide is about 20 showcase schools, and the rest of us are struggling to get on," says Leslie Fretzin, technology coordinator and computer teacher for Jean Baptiste Beaubien Elementary School.

Obstacles to Technology

In light of these concerns, using computer technology in classrooms remains goal for the future, but one the system seems hard-pressed to achieve with urgency or consistency.

Among the challenges in Chicago:

- *Difficulties with technology planning.* The Illinois State Board of Education requires all school districts to submit technology plans to receive grants and supplemental state and federal funding for technology. Due to the vastness of the Chicago school system and the tremendous variations among schools — some are neighborhood schools, some are magnets, some retain special identities as academies with theme-based curriculums — the state also requires each school to submit its own technology plan. Although some Chicago schools with similar interests or common partners have been allowed to submit group plans, most have submitted, or are working to submit, individual plans.

Few doubt the benefit of having a technology plan that's clearly aligned with a school's curriculum and its goals. Such plans are a necessary and important step in allocating technology resources, advocates and others say. But schools lack personnel with the expertise to develop such plans and to tie the plans to specific teaching goals and objectives, many Chicago educators report. One measure of the difficulty facing schools: As of this spring, only 315 of the district's 589 schools — slightly more than half the schools in the district — had their technology plans approved, according to Shirley Berry, director of the Illinois State Board of Education's Area VII Hub. The hub, which receives both state and local funds, helps schools with staff development, grant writing and technology planning.

"Our district asks that each school write a plan because the schools are locally administered, their needs are different, [and] their plans of action are different," Berry says. "There are so many schools in this system, they're so diverse, it would be hard to write one plan that would work for them all."

According to Berry, the most common reason a plan is rejected is a school's failure to convey how it will actually use technology to engage students in learning.

Some technology coordinators complain, though, that after having plans rejected, they were left with the distinct impression their plans had not been read thoroughly. "We were told we hadn't included the school's report card in the table of contents," says Fretzin of Beaubien Elementary School. "I said, Yes, we did. It's on page 80. You didn't read it, did you?"

Fretzin also chafes at the strictness of the technology plan format. "They wanted our teaching strategies numbered. Ours were bulleted," she says. "We were told the strategies weren't there, but they were. They just weren't numbered."

A number of schools also had submitted technology plans so that they could obtain federal E-rate discounts only to have to rewrite their plans when FCC regulations changed.

At the same time, some schools have gone ahead without submitting a plan. But given the tight budget constraints schools face, few can now afford the costs of wiring their buildings for schoolwide Internet access without state and federal funds.

Locally, too, technology plans remain the gateway to district resources. At a regional meeting of principals and technology coordinators (Chicago is divided into six regions), an architect overseeing the wiring of the schools announced that the board would finance a T1 connection to every school in the district. But, he continued, those schools that had not yet had technology plans approved would likely have to wait two to three years to receive the discounts they'd

CHICAGO PUBLIC SCHOOLS

Student-to-computer ratio	
(all computers)	9:1
(computers meeting district standards)	17:1
Student-to-multimedia computer ratio	Not available
Schools with a local-area network	Not available
Schools connected to a wide-area network	200
Schools connected to the Internet	308
Classrooms connected to the Internet	Not available
Total number of classrooms	Not available
Type of Internet connection	
Dial-up access	199
ISDN	46
T1	63

SOURCE: Chicago Public Schools

CHICAGO PUBLIC SCHOOLS

Percentage of computers at grade levels	
High school	Not available
Junior high/middle school	Not available
Elementary school	Not available
Location of computers	
Computer laboratories	41.1%
Classrooms	49.4%
Media centers/libraries	3.8%

SOURCE: Chicago Public Schools

need to secure full connectivity to the Internet and access to the school system's wide-area network.

That means that T1 lines would be installed, but that schools would likely have to pay full price for the wiring work to connect those lines with the rest of the school. When one technology coordinator revealed her school's intentions to go ahead and wire the school to the Internet with its own funds, the architect warned that there would be no guarantee the work would not have to be redone if it didn't meet the district's network standards.

● *Lack of funding for technical support.* In the summer of 1997, the school district closed its central drop-off facility for computer repair, a move that has left schools responsible for maintaining and troubleshooting their own equipment, including their computer networks. Few schools, though, have the resources to fund a full-time technology coordinator or technical support specialist. Nor does the district fund such a position, reasoning that if a school wants such services, it can contract for them or hire someone through discretionary funds or state poverty funds (called Chapter One funds).

Many schools say they can't fund such positions out of discretionary funds, though, because they're forced to use that money for other purposes, including hiring teachers. Due to enrollment fluctuations, some schools lose board-paid teaching positions at the start of the school year only to find they need additional teachers later on when the school fills up. Often the teachers of core subjects must be hired through discretionary funds, these schools report.

And even schools that have hired technology coordinators admit the expense puts the brakes on progress. "Simply having the board pay for my position would free up $55,000 additional dollars for the school to use for technology development," says Pam Coleman, technology coordinator for Hannah G. Solomon Elementary School, a K-8 school on Chicago's northwest side.

Schools striving to embrace technology have also asked librarians or computer teachers to shoulder the work of technology coordinators, network troubleshooters and grant writers. Of those interviewed, though, many complained that negotiating the bureaucracy, fulfilling all the requirements for submitting a plan, applying for grants and learning about the various technologies were full-time jobs beyond their original full-time commitments. One claimed to know of several technology coordinators or technology teachers who left the district for jobs in neighboring suburban schools where less would be demanded of them.

Hiring an outside contractor to maintain a network or troubleshoot simple problems such as a broken printer isn't always desirable either, schools report. Outside contractors are necessary for equipment maintenance, but schools report it's much more convenient to have someone on hand at all times to address problems immediately.

In many cases, too, schools say they are reluctant to run up billing for outside services. Instead, they put off making the calls for service in favor of having a teacher or other staff member attempt to fix the problem. That practice, though, can disrupt the flow of teaching and technology integration if the school's technology begins to prove unreliable.

Again, some schools have found their own solutions to the problem. Using state Chapter One funds, Shields Elementary hired a technology coordinator who does nothing but maintain the network and work with teachers on integrating software into their lesson plans. That coordinator has become so familiar with the equipment that she now makes minor repairs herself. She's also taught seventh- and eighth-graders to troubleshoot simple problems.

● *Aging facilities that impede the installation of cabling, wiring and other necessary infrastructure to support computer technology.* Chicago's board of education has agreed to install a T1 line and a network server in every Chicago school, often beginning first with newly constructed annexes and additions. (According to the district's current technology plan, half of the schools have no Internet access, and those that do typically have a single dial-up modem for the entire school.)

Schools, though, have to fund hookups to classrooms, computer labs and libraries. Old schools without new annexes face more formidable barriers. In many cases, construction work is held up when lead paint, asbestos and century-old walls more than a foot thick make it difficult — or impossible — to string cable.

The costs can be high. Wiring work alone for one older school building was estimated at $75,000 and had to be budgeted over a five-year period at $15,000 per year.

According to the district's technology plan, the Department of Learning Technologies, which provides teacher training and technical support, receives $3.4 million of the $2.9 billion budgeted for centrally managed services. Another $64 million is being spent on the district's wide-area network. By way of comparison, the board has committed $46.9 million to expanding its prekindergarten program. It spends $116 million on its management information system.

SCHOOLS WHERE TECHNOLOGY WORKS

For all the obstacles it faces, Chicago does have schools that are making exemplary use of technology. At **Christian Fenger Academy High School,** a neighborhood public school serving 762 students on Chicago's south side, students use computers with an innovative science curriculum that emphasizes the environment.

Four years ago, the school started teaching environmental science and was looking for a way to bring more technology into its classes, says biology teacher Karen Baker. To suit its own special needs, the school adapted an interactive science activities program known as CoVis, which had been developed by Northwestern University.

Today, earth science students use computers to do problem-solving activities and construct models that simulate environmental hazards and issues. This year, students studied the issue of overpopulation in several cities worldwide. Students not only had to define the problem and describe its effects on the environment; they also had to look for causes, such as housing characteristics and religion, by tapping into information available on the Internet.

The earth science software contains prompts that ask students to pose their own questions: How much algae in water is necessary to harm fish? Is the amount the same for all species of fish? What ingredients in local pollution cause algae growth?

Reading these prompts and responding to them are valuable activities for many of the school's students, who are weak in reading and writing, says Baker. Only 10.1 percent of Fenger's freshmen and sophomores who took the Test of Achievement and Proficiency (TAP) last year scored at national norms.

Overall, the school has approximately 150 computers, about 35 of which are in a science/language arts lab (where the earth science students meet) and in a smaller mini-lab. The rest are in three vocational labs. Internet access was made possible in the science/language arts lab through the CoVis program, which supplied the funds to install a T1 line to the school.

The Chicago High School for the Agricultural Sciences, a public magnet school that draws students from throughout the city, also has had success with technology. The school has a graduation rate of 86 percent, and many of the school's graduates later obtain college degrees in horticulture, food science, veterinary medicine, marine biology, aquaculture, farming and other fields.

With 188 computers for 563 students, the Chicago Ag school, as it is known, has one computer for every three students. This translates into approximately three computers per classroom and two large computer learning labs.

Students in business and finance classes use those computers to participate in stock market games that require them to use the Internet to research stock prices. Senior projects have become elaborate productions, complete with slide shows and PowerPoint demonstrations. All freshmen are required to take computer classes that teach basic computer skills, such as keyboarding, doing research on the Internet, and using word-processing and spreadsheet programs. Students also learn how to number pages, set margins and tabs, and use files and folders so that they can store, retrieve and use the information they uncover.

In the fall of 1998, too, this school appeared light-years ahead of many older schools in Chicago in part due to a recent 150,000-square-foot expansion that paved the way for Internet access. The original school structure was built in 1954, with a subsequent addition in 1987. The existing structure was 30,000 square feet, about a fifth the size of the addition.

While the new addition is an advantage, Principal Barbara Valerious and the school's local school council face many of the same barriers other schools face in terms of financing equipment and maintenance. To underwrite some of those costs, the Ag school rented the entire high school to the State of Illinois for the Illinois teacher certification tests last summer. That arrangement yielded approximately $1,500 for the school. Occasionally, too, the Ag school rents a classroom, gymnasium or a multipurpose room to a local Catholic grade school. The latter arrangement only yields about $25 per rental, but, Valerious says, "every little bit helps."

The school's local school council has been supportive of training efforts as well, assigning funds so that teachers can obtain training during school hours and hiring substitutes to take over their classes. Efforts also have been made to obtain used computers from school sponsors and members of the business community for teachers' personal use, banking on the theory that if teachers can become acquainted with computers at home, they'll use them more readily in the classroom.

At the elementary school level, **James Shields Elementary** is also making gains. At Shields, many classes use small-group workstations that include computers and other resources. Working at these stations, students might read nonfiction books as well as storybooks about frogs and then report what they have learned to other class members.

Software selection has been key to the school's efforts. Rita Schuble, the school's technology coordinator, and Rita Gardner, its principal, say they and others at the school take special pains to buy software that will serve specific curriculum needs rather than programs oriented toward drill and practice or games. They also have teachers test the software before purchasing it and look beyond the most heavily advertised popular brands.

The result of the school's overall efforts to revamp its curriculum: Between 1990 and 1998, Shields's scores on the ITBS

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SCHOOLS WHERE TECHNOLOGY WORKS, continued from page 13

(for grades three through eight) rose from 20.2 percent reaching national norms in reading to 33.8 percent. In mathematics, scores rose from 27.5 percent to 40 percent.

At the same time, the school's enrollment increased from 955 to 1,649, and its percentage of students from low-income households rose from 60.5 percent to 94.5 percent. The number of limited English proficient students also climbed from 21.4 percent to 36.7 percent.

One measure of the school's commitment to technology: While Shields has expanded its teaching staff to accommodate increasing enrollment, its classes still remain large, with as many as 42 students to a class. Rather than simply hire more teachers to reduce class size, the principal, local school council and parents have opted to invest further in technology.

● *Lack of teacher training and resistance on the part of some teachers to make use of computer technology.* While computer technology may already be operational in some schools, many teachers are reluctant to move beyond drill and practice or word processing to using computers for research and presentation. One teacher complained that the two computers in his classroom were a distraction, and that many students cut short the time they devoted to their lessons so they could finish early and tinker with the computers.

Another pressure point within the system: More than ever before, teachers are being held accountable for raising standardized test scores. And under the gun, many older teachers fall back on more traditional teaching methods. Yet dips in test scores are common during periods of technology integration, observes Karen Percak, technology coordinator/librarian at Wildwood School on Chicago's northwest side.

"As long as we are held accountable for standards only viewed by how students score on tests, and those tests don't speak to some of the skills addressed by computers, you're going to find resistance on the part of teachers to using technology," says Percak, who trains teachers from Wildwood and other schools in the use of computers and instructional software. "I'd like to see the board waive one year for this accountability during the setup period. I can predict there would be tremendous gains later, just not right away."

● *Disillusionment.* In Chicago, as in other large urban school systems, time lines can quickly expand from months to years. Indeed, the Chicago board of education often promises completion deadlines only to break those promises, teachers and principals say.

All schools in the district, for example, were supposed to have T1 lines installed before Christmas 1998, but that completion date was moved first to February 1999 and then to June 1999 or beyond.

Henry Parker, manager of the Department of Learning Technologies, acknowledges that delays have slowed the district's efforts. "What we needed to do yesterday needed to have been done the day before that," says Parker. Among the factors Parker cites are the limited number of contractors available for the massive job of linking the district's 583 schools and the age of the district's buildings.

Those delays, though, leave principals and teachers disillusioned about when and, in some cases, if they will have full access. It also means that many educators become less willing to uphold their end of the paperwork and time commitments needed to secure technology for their schools. "We're no further along than we were last year at this time," remarked a technology coordinator who refused to be identified at a regional meeting last fall. "I'm really sick of this."

Still others report they were naive about the complexity of the process involved in securing infrastructure for their schools. The T1 lines the district is installing are to be used for administrative purposes foremost and for tapping into the district's wide-area network. Most lines are also being installed in new buildings or annexes or near central office areas rather than near the computer labs, libraries or classrooms. The disappointment comes when schools learn they must fund the wiring and voice and data cable connections on their own — a task that involves an intricate application process for state and federal funding, discounts, grants and supplements or extensive fund-raising.

Some administrators also say they fear the district doesn't have the foresight to sustain technology into the future. "The board looks at this more as something like building an addition to the school," says Elena Savoy of Wildwood Elementary School on the city's northwest side. "It's sort of like, OK, you've got what you wanted and that should be it. But it doesn't work like that. The technology continues to change, and maintaining it will be a challenge."

Chicago's systemwide technology plan calls for schools to shoulder the responsibility for maintaining and upgrading equipment.

● *Gaps in funding.* Amounting to about $260 million in 1998–99, state anti-poverty funds, which are distributed to each school, drive many technology programs in Chicago. "If it weren't for this poverty money, . . . we wouldn't be able to do it," says Savoy of her school's technology effort. In 1993–94, the school had a 93 percent poverty rate and used $60,000 of its Chapter One money to buy 15 Macintoshes, some printers and tables to get started. Another school, Thurgood Marshall School, has hired a professional grant writer through Chapter One funds.

Federal Title I funds, about $120 million of which are distributed to the schools, also play a role, but the way those funds are distributed causes problems for some schools. According to statistics from the school system, 84.5 percent of its students qualify as low-income by federal standards. The students' dispersal throughout the system is quite uneven. Some schools have concentrations of low-income students as high as 90 percent or more, while others have concentrations in the 30s, 40s and 50s. And some schools in affluent neighborhoods have few low-income students.

Federal funds are distributed on a sliding scale that takes into account the poverty level of the children who attend a school. Schools with the highest poverty rates get the most in federal funds; those with lower rates of perhaps 70 or 80 percent get less. This year, schools in the district with a poverty rate of less than 56 percent, got none.

"We don't serve all schools," says Sandra Tolbert, manager of grants administration and development for the school system. "There aren't enough dollars."

In the past, too, the district has distributed aid based on the poverty level in the neighborhoods surrounding the schools. That practice left schools in affluent areas without federal aid even though they enrolled large numbers of low-income children, bused in from other neighborhoods.

Two elementary schools constrained by these circumstances are Solomon and Wildwood. Fifty percent of Solomon's students come from Chicago's west side, a poor area of the city. But the school doesn't receive any federal funds for those students, says Coleman, the school's technology coordinator.

Wildwood's situation, on the other hand, has changed somewhat in the last couple of years, with the percentage of children at the poverty level declining from 90 percent to 80 percent in this school, which also is located in an affluent area. "There's less money to work with under these circumstances," says Savoy. "That's why you don't want to lose your low-income students."

Says Coleman: "We scramble for enrollment. Many schools have been known to overload classrooms to obtain bigger totals for state Chapter One funds."

At the same time, some of the district's lowest-performing schools — schools that receive significant amounts of federal funds — haven't taken advantage of technology. Others have bought the equipment but haven't linked it to a school improvement plan.

● *Contractors who prey on unwary principals, librarians and technology coordinators.* While the board of education has specified three major contractors for infrastructure work, many smaller operators call upon the schools, attempting to secure contracts. In many cases the contractors are most interested in using such agreements to prove they have worked with the Chicago board of education. "It's a feather in the cap, a marketing tool for doing business in the Chicago region," one principal explains. Some contractors even pose as representatives of larger contractors.

The problem has become a common complaint among principals. Some parties even go so far as to put correspondence on what appears to be official CPS letterhead, says Margaret Niedermaier, principal of Eliza Chappell Elementary School on Chicago's north side. One letter Niedermaier received looked as though it had come from the Chicago Public Schools. But when Niedermaier read the letter carefully, she determined that it hadn't. "You had to search, to read the fine print," the principal says. "It happens constantly over the fax machine."

A Role for the Central Office

How difficult will it be for a decentralized district to overcome such obstacles? Many researchers say the answer to that question isn't clear yet.

To its credit, some researchers say, Chicago has made efforts to help schools with centralized support, but that support is clearly stretched thin given the size of the district.

The district's Department of Learning Technologies has 26 teacher trainers as part of its Technology Resources Network. These trainers, all former teachers, help specific groups of schools with on-site teacher training and information on writing technology plans, using the Internet and networks and developing instructional materials.

But with 26 teacher trainers spread over six regions, 589 schools, and 28,000 teachers, there's a lot of ground to cover, acknowledges Dan Anderson, director of teacher trainers for the district. Anderson estimates that each teacher trainer works with between 20 and 25 schools.

At the same time, demand for teacher training is high. Last October, the district sponsored a technology train-ing conference for classroom teachers at Chicago's McCormick Place convention center. The one-day event drew 4,500 participants, far more than were anticipated, and approximately 1,500 had to be turned away, Anderson says.

CHICAGO PUBLIC SCHOOLS

Total annual technology budget	$132 million
(4% of $2.9 billion for centrally managed services)	
Source of technology funding	
Local operating budget	44.4%
Federal funds	12.8%
State funds	28.6%
Grants	0%
Other	14.3%
Ratio of full-time technical support to schools	1:93

SOURCE: Chicago Public Schools

COLLEGIALITY, COOPERATION, AND COMPUTERS

It's nearly noon on a Monday at Daniel Carter Beard School, a small public school for special education students ages 3 to 9 on Chicago's northwest side. Eighteen teachers, a principal and the school's technology coordinator are gathered in the library to attend a workshop on the basics of using a Macintosh.

Helen Hoffenberg, a teacher trainer from the district's Department of Learning Technologies, begins by polling teachers about their use of computers. Most say they use computers for word processing. A few write e-mail letters to sons and daughters away at college. But almost all qualify their statements by adding that their use of computers has been helped along by spouses and younger children in the family.

The exception is one young teacher who says that she and her husband regularly peruse the Internet and use computers for everything from paying bills and budgeting household expenses to calculating savings.

The number of novices doesn't surprise Hoffenberg. "Taken as a whole, we can see, that for most adults, working with computers is like trying to learn a second language," the teacher trainer says. "We have to accept that and begin to move on."

Move on they do. Hoffenberg guides them through simple lessons on the use of ClarisWorks, a software program that provides a variety of templates for producing letter forms, newsletters, address books, envelopes and even business cards.

She asks teachers to write a sample letter to parents, and while most have no problem, one woman with more experience with computers than the others quickly tires of the exercise. I know how to do this. What's to learn?" she says to a colleague.

Nearby, another teacher struggles through the sequence of commands that will bring her to the blank screen where she can begin writing the text of her letter. When she has difficulty moving the mouse to indicate appropriate choices on the screen, the teacher who's lost interest suddenly steps in to help.

What both teachers learn in that moment is far more important than how to use a drop-down menu, Hoffenberg says. Such mutual support and collaboration are key ingredients to introducing technology into the schools.

That kind of collegiality occurs at Wildwood Elementary School, also on Chicago's northwest side, where teachers spend the Wednesday afternoon before Thanksgiving participating in a workshop called Taste of Software, named after the city's annual summer festival, Taste of Chicago. Karen Percak, the school's librarian/technology coordinator, has organized the event.

Teachers are asked to sample grade-appropriate software, design a corresponding lesson plan and share their thoughts on the value of the software with those who teach at the same grade-level.

The teachers take turns giving sometimes concise and sometimes elaborate demonstrations of the software, with other teachers asking for clarifications on functions. One demonstration includes a writing program that combines pictures with English words to allow children to write in a second language. Though there isn't enough time for all of the teachers to demonstrate, Percak notes the enthusiasm.

"One teacher today was singing in the cafeteria, she was so glad to do her demonstration on making pop-up books," says Percak. "And at the end of the day one male teacher complained, 'I didn't get to do my presentation,' like, darn, he didn't get to do it. He really wanted to."

Adds Percak: "I'd say teachers are pretty excited about using the technology."

The Chicago Panel on School Policy also reported last spring that half of the staff members in the elementary schools it surveyed said that lack of teacher training was a factor that had limited the introduction of technology in their schools. A similar percentage also said they had not received enough training to be comfortable using technology in the classroom.

Others assess Chicago's situation more harshly: CPS administrators have made a limited commitment to learning technologies, they say, leaving the responsibility for technology largely to local schools.

The sheer number of schools and programs competing for central technology resources also takes a toll, and so does Chicago politics, says Dany Fleming, a research analyst with Leadership for Quality Education, a school reform group. Political pressures in the city often force the district to distribute resources strictly among the city's six regions, even if equity means no school gets enough to do the job properly, Fleming says.

The result: Hefty donations from computer companies are dispersed across the system rather than concentrated where they might make the most difference. Offers for partnerships with corporations are divvied up so that schools that might not be ready to partner — but who are in the right region — end up involved.

"It's the politics of a large district," says Fleming. When the district offers a pilot program, it's faced with the prospect of "a lot of people banging at the door."

Another complication: Many schools don't know how to use the centralized resources that are available. A report from the Chicago Systemic Initiative, part of the National Science Foundation's Urban Systemic Initiative,

reported that two-thirds of the 5,500 teachers it surveyed said they had used a computer. Still, 43 percent said that they were either unaware of or had not attended any of the technology training workshops the district offers.

Often, too, schools don't have a clear idea which responsibilities are theirs and which are the central office's. That's especially true about responsibilities for linking schools to the district's wide-area network.

The district has a good idea of its responsibilities, says Fleming, but most principals — who must oversee their own schools' wiring — don't. "You start talking about electrical systems and the different kinds of wiring and when you get down to the nitty-gritty, principals' eyes just glaze over," Fleming says.

The district has attempted to address that problem and has sent out teams of specialists to assess each school's networking needs and discuss responsibilities. That process is hindered by Chicago's scale, though. By the time teams visit schools, prices and network configurations will likely have changed, says Fleming.

"Scale is just a major obstacle," says Fleming. "It makes people at the macro level very nervous."

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② DETROIT

Equity, access and accountability slow Detroit's progress

By Amber Arellano

Martin Luther King Academy in Mt. Clemens, Mich., is just 20 minutes away from Detroit's Martin Luther King Jr. Senior High School, but the two are worlds apart when it comes to school technology.

At MLK Academy, students have free home computers, and parents receive free computer training. A technology director meets weekly with teachers to ensure they use technology to support their work. And every classroom has Internet access.

At MLK High School, a well-known Detroit magnet school, few teachers use technology with their classes. Out of five computer labs, only one is used regularly for instruction. The rest sit, malfunctioning or unused. There are no parent workshops.

What accounts for the difference in the schools? For years, the simple answer would have been because MLK Academy is suburban and better financed while MLK High School is situated in one of America's poorest school districts. But increasingly, fewer parents and leaders are willing to accept that as the whole story.

Indeed, the debate over what makes the critical difference in improving Detroit's schools — money or management — has grown fierce and more public than it's been in decades. This year Michigan's Republican-controlled state Legislature is expected to authorize either a state or mayoral takeover of the district's 264 schools. And for the first time, the mayor of the predominantly African-American city, Dennis Archer, who typically opposes state decision-making on Detroit, announced in December he would support such a measure.

Nowhere, though, is dissatisfaction with the city's schools more apparent than in the decision of a number of Detroit parents to enroll their children in independently run charter schools. Michigan has more than 125 such schools, and the number is expected to increase if Gov. John Engler lifts the state's limit on charter schools in 1999, as he has promised. (The state currently allows 150 charter schools.) The state leads the United States in for-profit Edison Project schools, with 16 of 51 nationwide. There are years-long waiting lists to get into such schools, including the Detroit Academy of Arts and Sciences, the first Edison school in Detroit. For the 1998-99 school year, 1,100 families applied for 120 student openings.

Part of parents' frustration is the inequity among Detroit's public schools. Some schools, such as the Dewey Urban Education Center in the city's destitute Cass Corridor, have some of the country's most progressive curriculums and most ambitious technology programs. Dewey has come from having no public address system or fax machine in the early 1990s to being one of the district's lighthouse schools today. It has a full-time technology teacher and resource person, elective classes, training for all teachers and a curriculum that few Michigan schools have attained.

Most schools, however, aren't nearly as advanced. Richard Quick, a computer applications teacher at Detroit's MLK High, says he tries to avoid showing parents the school's technology program at open houses. Like many Detroit schools, MLK lacks a corporate partner to pay for new equipment. So its labs wait in limbo, with wires dangling out of dust-covered computers, for reform that might make technology a priority. The school has no computers in its regular classrooms.

"I think we're pretty typical in Detroit," Quick says. "There are a lot of schools ahead of us, but a lot more behind."

DETROIT PUBLIC SCHOOLS

Number of schools	264
Total enrollment	177,057
Demographics	
African American	86 %
White	5 %
Hispanic	3 %
Asian/Pacific Islanders	>1 %
American Indian	>1 %
Free and reduced lunch	84.5 %

SOURCE: Detroit Public Schools

An Innovative Science Curriculum

On a chilly Tuesday morning at Detroit's Farwell Middle School, Alicia Meriweather is trying to wake up her 24 seventh-graders with science experiments they'll remember forever.

First she burns paper, then a marshmallow. Later she sets a chunk of steel wool on fire. Each time, she barks: "Write down what you see!" Her mission: to teach the difference between physical and chemical properties, and, eventually, for her students to develop hypotheses on their own.

Shadowing the students' desks is Deborah Peek Brown, a veteran Detroit science teacher on leave from her classes to implement what's considered among the best new science-technology curriculums nationwide. (See "A Lighthouse School in Detroit's Cass Corridor," page 24.)

Later, the students will head down the hallway to Farwell's Macintosh-IBM lab, where they'll build computer models on a program designed for the curriculum, do research on the Internet and write their reports. Meriweather and another participating teacher, Pam Williams, say the technology catches students' interest more than anything else they have tried.

"The kids ask everyday, 'Are we going to the lab today?'" says Meriweather. "Some have said, 'I feel like a businessperson,' because they created something on a computer."

The approach, to promote scientific inquiry rather than old-fashioned memorization, is just one reason the program is so unique. It also uses tailor-made technology to give students a way to visualize their own hypothesis models on a computer. Finally, it provides teacher training and extraordinary human support that seem to make a crucial difference in curriculum reform.

Brown, for example, will talk later with Meriweather and Williams about how the curriculum is working in their classrooms. She'll provide a listening ear ("How did the Word Wizard worksheet go?") and assist with problem-solving (today, she offers to find acid for an upcoming experiment). More than anything else, she connects the teachers to an outside network of support to help them change their practice.

"Teaching is one of those professions that once you're certified, you're alone," says Meriweather during her lunch-break discussion with Brown. "With this program, you're not just the Lone Ranger."

Training Needs

Such support and training are critical issues in Detroit and across Michigan. In a 1997 DPS survey, schools reported teacher training to be their No. 1 need if they were to implement technology in their classrooms. Similarly, a survey of one-third of Michigan's schools asked teachers, "What kinds of staff development do you need?" In both 1994 and 1996, technology was No. 1.

"If they've listed it as No. 1 for a second time in a row, then you know it hasn't been addressed," says Leah Meyer Austin, program director at the Kellogg Foundation in Battle Creek, Mich., which conducted the survey.

Indeed, when Detroit began to implement a new technology plan in 1995 (the plan is now being revised), the district's Web site heralded the start of the most ambitious training program in its history. Free classes on basic computer training and Internet skills were held nightly for any teacher interested, says Mike Flint, who taught some of the classes and helped develop the district's technology system. The program had a three- to four-week waiting list.

About two years ago, however, the program was cut. A change in administrators occurred at the same time. Current DPS leaders say the changes were made under the district's move toward site-based management, which has shifted the responsibility — and the funding — for such programs to the school level, says Assistant Superintendent Juanita Clay Chambers. "You don't find a lot of funds anymore at the central level," Chamber says.

Schools don't necessarily allocate funding for training or technology, though. For example, in 1997 when Dewey — a school known for its technology commitment — had to fund a monthly workshop for technology teachers under the new funding structure, its computer teacher, Margaret Carden, was told she'd have to pay for the workshop herself if she wanted to continue going.

Further, Chambers said the district has no way of knowing how many schools are providing technology training because it does not keep track of such information. However, all DPS teachers, in one capacity or another, have been trained to use technology to support the DPS curriculum, Chambers says.

Schools, though, report the need for such training. "That's on my wish list," says Carolyn McKissic, the principal of Howe Elementary, one of the first schools in Detroit to put computers into classrooms. Training, rather than access, is her school's problem. Every classroom has at least four computers, but few teachers know how to use them with the curriculum. About half of Howe's 30 teachers have just basic computer skills, such as running a word-processing program, McKissic says.

Districtwide, a September 1998 DPS report says only 8 percent of Detroit's teachers used technology in their classrooms, according to Geraldine Carroll, DPS's director of educational technology.

Technology specialists who train

DETROIT PUBLIC SCHOOLS

Student-to-computer ratio	9:1
Student-to-multimedia computer ratio	22:1
Schools with a local-area network	220
Schools connected to a wide-area network	264
Schools connected to the Internet	220
Classrooms connected to the Internet	3,000
Total number of classrooms	8,000
Type of Internet connection	
Dial-up access (line dial-in network)	172
ISDN	0
T1	220
T3	0

SOURCE: Detroit Public Schools

teachers, answer questions and take responsibility for the school's technology program are also rare. University of Michigan researcher Barry Fishman says just a few of the 10 schools he visits have such a technology person. "That's one thing schools are slow to recognize they need," he says.

Adds McKissic: "I'm trying to get the money for someone. Right now . . . a tech specialist is just as important for me to have as a good reading teacher."

In Search of a White Knight

Faced with dismal infrastructure, sorry budgets and little federal and state support, many of America's poorer, large urban districts have struggled to wire their schools. In Detroit the story is no different. For one thing, under conservative Gov. John Engler's free-market philosophy, the state has offered no major technology policies beyond a handful of school grants.

"Equitable access is our top concern," says Ric Wiltse, executive director of the Michigan Association of Computer-Related Technology Users in Learning, a professional training group for teachers. Despite a record number of bond measures that have passed in recent years, many communities are still playing catch-up with technology, he says.

"Some people just can't afford the additional taxes," says Wiltse, who is now lobbying for more state support. "I really think it has to come from state and federal funding, across the board — not in a competitive grant program."

In a highly centralized district such as Detroit, support must also come from the district's central office. Detroit remains among the most centralized urban school districts nationally, despite its recent announcement that it would move to site-based management. Unlike Chicago or other highly decentralized districts, Detroit is like a spider web; almost every school issue somehow links back to the center.

On technology, that can be a plus, since many technology services, such as wide-area networks and professional development, must be centralized for cost savings, some researchers say. Without centralized support, too, there's the danger that rich schools will get rich and poor schools will fall further behind.

Detroit public schools aren't quite that extreme, but they are still highly inequitable. For example, the district's 1997 survey showed that some schools, such as Goodale Elementary, reported they didn't have a single computer while other schools had computers in every classroom. In Detroit, a school's progress with technology often depends on luck and "who you know," as Quick puts it.

Traditionally, the city's magnet schools have attracted the best of the city's resources. In many cases, that still holds true. At Bates Academy, a K-8 magnet school that enrolls the children of many of Detroit's power brokers, parents have donated IBM computers to any teacher who has wanted one.

The school has so many donated computers of various ages — new G3 Macs, recent Macs, and older Apples — that at least a dozen sit unused in the computer applications classroom.

At the same time, based on the 1997 survey, many non-magnet schools are also far ahead in access and curriculum use. In fact, a better predictor of a school's progress is its personal and business connections.

Western International High School on Detroit's poor southwest side, for instance, was able to obtain several computers through a parent who worked at New Detroit, a city school reform organization, says Lois Murphy, Western's technology teacher of 11 years.

Tech-savvy, determined principals also make or break a technology program. And in schools lacking technology leadership, outside foundations and reform groups have fostered change. Before 1998, for example, only students in language arts classes had access to computers at Farwell Middle School. But when teachers began to work with the University of Michigan's science reform curriculum last year, DPS wired the school for Internet access to support that curriculum, and Farwell's principal opened the computer lab to students outside the language arts. Teachers had asked for Internet access for all students for months, but without the university's involvement — and its contribution of $7,500 for materials — "it would've been a lot to ask," says Brown.

The University of Michigan's involvement also spurred the district to install a T1 line and routers at Carver Middle School in 1998, Brown says. Teachers had been requesting the updates for a few years.

But by far the most important factor is corporate sponsorships, the 1997 survey and educators reported. The more partners, the more likely a school was to have not only access but resources for hardware and software.

MLK High hasn't succeeded in finding a corporate white knight and has suffered, even though it boasts of having some of Detroit's best secondary magnet programs. Teachers, parents and students have formed a technology committee to lobby the district for funding. But while MLK has a $5 million technology plan, it still hasn't received district funding or support. And without it, Quick is skeptical MLK will change in tightly controlled and centralized Detroit, despite the move toward site-based management.

"The district's got to make it [technology] a priority," Quick says. "There's not an across-the-curriculum approach."

Accountability Is an Issue

Neither is there accountability for implementing technology programs. No one in the schools is responsible for mandating technology use or integration, much less for caring for the equipment itself.

Chambers says establishing better district curriculum guidelines is what drives school change. And she offers a 1998 curriculum book the size of a telephone directory that includes technology-integration guidelines as proof the district is moving on such reform. "Technology is part of achieving excellence," she said in a December interview. "That's a mandate."

DETROIT PUBLIC SCHOOLS

Percentage of computers at grade levels	
High school	40 %
Junior high/middle school	35 %
Elementary school	25 %
Location of computers	
Computer laboratories	80 %
Classrooms	10 %
Media centers/libraries	10 %

SOURCE: Detroit Public Schools

But with no training to teach educators how to use the guidelines and most teachers lacking access, major reform seems unlikely.

"Accountability is a major problem in every area," says Robert Brown, project director for youth development for New Detroit, the city's major school reform group. "You don't have procedures, you don't have standardized performance evaluations, you don't have major training in place. . . . Until there's a fundamental systemic restructuring, change is really not going to take place."

Until recently, too, the push to connect schools to a high-speed network has put some schools out in front and left others behind. In April 1998, DPS reported on its E-rate application that only 1,000 of the district's 8,000 classrooms had been connected to the Internet. DPS applied for help in connecting all of its 264 schools. By late 1998, the district reported it had wired 190 schools for Internet connectivity, according to Jim Davis, the district's director of information systems management.

The problem has been funding. Indeed, just to wire what it has so far, DPS had to "rob Peter to pay Paul," says Davis. Beyond that, he declined to say how the district paid for its wiring from 1995-1998, except to say that a half-million-dollar Ameritech grant helped get the district started in 1995. "E-rate is the godsend," Davis says.

In late 1998 and early 1999, however, two things happened that made wiring Detroit's schools both a financial reality and a priority. First, a statewide lawsuit settlement left Detroit with $60 million in unexpected money. With the necessary funding, DPS announced in February that all of its schools and all 8,000 of its classrooms would be wired by April 1. One caveat: Infrastructure problems could push back the April 1 goal. Some schools — about 60 so far — have had serious problems with asbestos or telephone cable so old it wouldn't carry a computer signal, so the wiring work has been stop-and-go, Davis says. But the work should only be weeks behind, he says.

Meanwhile, DPS's fiscal year ends July 1, meaning the district must get all schools' computer systems on a Y2K bug-free network, Davis says. The threat of computers' crashing prompted the district to wire more classrooms in a few months than it had in three years. "Year 2000 became the problem," Davis says.

And even if the district finishes wiring schools with T1 and 56KB lines, that doesn't mean that teachers will suddenly be able to use the Internet for teaching. In April DPS will apply for a second round of E-rate funding. (The school system received $14.7 million in the first round — much less than other districts in this study.) It plans to use the next round of funds for the PBX switches, routers and hubs that schools will need to hook into the network, Davis says.

The Competition from Charter Schools

Eager for change — and reluctant to wait for solutions to funding shortages and slow-moving bureaucracies — Michigan's parents are turning to independently run charter schools where new curriculums, longer school hours and technology are easy to find.

In Michigan, the hotbeds for such schools are Rust Belt cities where job loss and urban flight have left districts scrambling for funds for decades. Pontiac, Flint, Lansing and Detroit now all have charter schools, including those run by the for-profit Edison Project, which expects to open five more schools in Michigan in the fall of 1999.

Technology sells in these districts. Last year, for example, Henry Ford Academy, Dearborn's science- and technology-focused charter school, had almost 700 students apply for 100 spots. Ford Motor Company is its sponsoring institution.

Technology has "marketing hype," says Tom Boudrot, director of technology for the New York-based Edison Project, which now has 12,000 students nationwide. "It's in the top five reasons parents come."

Forget that the research doesn't necessarily show that technology means improved student learning. Educators worry about such things, Boudrot says. Parents don't.

"It's like a car," says Boudrot. "When people talk about their cars, they never talk about anything specific. It's more about the aura of ownership."

Technology also sells with school officials in urban communities that cannot afford to provide computer access, says Blanche Frasier, the former superintendent in Mt. Clemens and now Edison's vice president of development, who pitches Edison to districts around the Midwest.

"When I tell people every child will have computer access both at school and at home, jaws drop," Frasier says. "That's really powerful, particularly in communities where few people have computers."

Faced with funding struggles and desperate not to lose more students to private schools and wealthier suburbs, Mt. Clemens, in 1994, became the first district in the nation to open an Edison school, MLK Academy. The district, although only a fraction of Detroit's size, is similar demographically: More than 45 percent of its 3,400 students are eligible for free- or reduced-price lunch.

Visit MLK and it's clear funding is

less a scramble than it is other places. Every classroom has a new computer, and the media room has two dozen new Macs. A full-time technology curriculum coordinator and technology troubleshooter is also on-hand.

Edison poured about $750,000 into MLK's technology program. For 600 students at the K–8 academy, that means about $1,300 per child.

Edison can spend so much because as a for-profit company, it has private investors to cover up-front costs. Since its inception in 1991, it's raised $161 million in venture capital. Its latest coup was a $25 million grant won from the founders of The Gap clothing store chain in 1998.

Such funding allows MLK to provide all teachers and students with up-to-date portable computers; free training for parents; staff to monitor the school's Web page, on-line homework hotline, and parent bulletin boards; and the best new classroom software annually.

Outside resources also make a huge difference at Dearborn's Ford Academy. Ford provides free training to teachers at the company's nearby professional development academy, says Sandy Kesavan, the school's technology coordinator. Once a month, a group of Ford engineers comes in and fixes any computer bugs.

Money, says Frasier, is not the only difference between charter schools and public schools, "but absolutely, it's the No. 1 issue. It's our advantage."

It's also the reason many urban leaders previously opposed to privatizing schools suddenly support state Gov. John Engler's push for more charter schools.

"Public schools don't have finances for technology," says Rev. Jim Holley, the pastor of Detroit's Historic Little Rock Baptist Church and board president of Detroit's first Edison school. "It's not an indictment; it's just the way things are."

Many Detroiters who support charter schools also argue that the city's schools could be doing more. "We've been working on reforming schools for so long, and it just isn't working," says Rev. Eddie Edwards of Detroit's Joy of Jesus, one of several city churches organizing parents into a lobbying group for charter schools called the Detroit Partnership for Parental Choice. In Detroit, such churches have wielded considerable political clout.

DETROIT PUBLIC SCHOOLS

Total annual technology budget	Not available
Source of technology funding	
State funds	Site-based
Local operating budget	$14.7 million
Federal funds	Site-based
Grants	Site-based
Other	Corporate donations

SOURCE: Detroit Public Schools

For these parents, curriculum, finance reform and technology are their top concerns. "First they need to be literate, then they need to be computer literate," Edwards said. "Unless we do something radical, we'll never catch up."

Continued on page 26

A PATCHWORK OF FUNDING

District officials declined to explain the school system's funding for technology in any detail, although they did sketch out some recent and future sources, including:

- About $100 million earmarked for technology from a $1.5 billion bond measure passed by Detroiters in 1994. According to Jim Davis, the district's director of information systems management, though, the district has spent only about $1 million of that sum, because the bond has been broken into series, and most of the technology component hasn't been issued yet. The district has been similarly slow with overall construction and renovation. Wiring schools will be difficult, though, in buildings where the infrastructure still needs work.

- About $8.4 million marked for routers and ATM switches in 1999. The funding came from a statewide lawsuit settlement, through which Detroit won almost $60 million in late 1998.

An additional $5 million in settlement money will go to technology-related infrastructure this year. All Michigan school districts received settlement funds (called Durant funds), and most are using the money for technology and related infrastructure, says Jamey Fitzpatrick, who recently stepped down as the state Department of Education's director of technology services. Detroit also will receive about $3 million annually from Durant for 10 years; about 50 percent will go to technology, according to a memo written by William Aldridge, DPS associate superintendent of financial services.

- The district has a $46.5 million 1998 budget surplus, but none of that money will go to technology in 1999. Davis wasn't sure how that will be used, but the Y2K problem is a good bet, he says.

- In the short term, Detroit's major technology funding will be the $14.7 million it received in E-rate funds.

A LIGHTHOUSE SCHOOL IN DETROIT'S CASS CORRIDOR

Its lawn is covered with broken glass, a homeless shelter is its neighbor, and burned-out federal housing projects under demolition loom across the street. But inside, Detroit's **Dewey Learning Center for Urban Education** shines. Its hallways are lined with children's artwork, while upstairs 22 students are building computer science models to help them understand how air conditioners, factories and other pollutants affect the environment and people's health.

"What harms a tree?" asks Margaret Carden, Dewey's computer lab teacher. "Acid rain, toxins, coal burning, like they did in the ol' days," answers Kenneth, an enthusiastic eighth-grader, as he types his answer on his computer.

With its commitment to whole language, Dewey is considered one of Michigan's most curriculum-progressive — and increasingly technology-smart — schools. In addition to other changes in the curriculum, the preK-8 school boasts of computer elective classes that support students' work in other subjects and science classes that use technology. It also has an on-line magazine design class for advanced students and an open lab, staffed by a full-time teacher, where students can do research using on-line encyclopedias and the Internet.

Its success is not only remarkable because of its struggles with wracking poverty, crime and its location in the city's Cass Corridor, an area known for prostitution and drugs. It's also because Dewey is using computers to support students' regular learning — a rarity in Michigan— says Leah Meyer Austin, a program director with the Battle Creek-based Kellogg Foundation, which has funded 13 comprehensive technology grants statewide. Dewey is one of them. (Two other Detroit schools also received such grants, though one lost its funding last year.)

The school also is unique because just a few years ago, there was no technology program in place. In fact, when Francis Parker became Dewey's principal in 1991, the school had no fax machines, no public address system, no televisions. The only hint of technology was a Title I reading lab built decades ago.

Dewey's success stems from a combination of a determined principal, a technology-savvy assistant principal, patience, luck and much support. Parker and her assistant principal, Jackie Spann, learned how to wire classrooms, recruited the help of friends, businesses and foundations, and changed Dewey's culture, all in seven years.

When they began their overhaul in 1991-92, their goals weren't so ambitious. Dewey's curriculum already had been revamped to a whole language approach with more emphasis on literature and literacy, and on hands-on activities. "Basically, our approach is that the teacher serves more as a facilitator, not a lecturer," says Parker. But the school had few resources to begin new programs such as technology use.

"We thought it would be heaven to get one computer in every classroom," says Spann, who had started using computers at home and as a teacher in the early 1990s. She raises her eyebrows incredulously. "Just one."

Dewey also had to contend with weekly burglaries. "Our biggest question was, how do we avoid getting our computers stolen?" says Spann. They quickly installed a security system, a new fence, protective grates over the school's windows and a secure room in which computers could be locked nightly, plus fax machines and phones.

Their next obstacle: money. Using Title I funds, they bought 15 Macintoshes and got a few more computers through donations from IBM and a local business partnership. They quickly ran into problems.

First, most teachers didn't know how to use the computers; some didn't want to. Very few had computers at home. And like many poor schools, Dewey had to contend with how to spread scarce resources — 30 computers — among almost 600 students. Under Title I requirements at the time, only Title I eligible children could use the computers, so teachers would have to split their classes and send Title I children to the computer lab, leaving the other students behind.

"About 86 percent of our students are eligible for free or reduced lunch, so now we're a schoolwide Title I school," says Parker. "Everyone can use the computers labs now. But then, access was really unequal."

So Dewey sought help. It applied for a Kellogg Foundation middle school grant, initially for $9,000, then for a $150,000 comprehensive grant to train teachers, improve technology delivery and buy more computers. Kellogg told them they were "regressive" technology-wise, but that their curriculum was progressive. Dewey won the funding.

With Kellogg money, Dewey's seventh- and eighth-graders gained regular access to computers. Teachers were trained by Kellogg's educators, who visited classrooms, assisted students and showed how technology could be used to support advanced thinking, not just remedial work. Meanwhile, though, elementary teachers and students were left out.

"I could see the school dividing based on technology," says Parker. "People were getting excited, but only on the middle school level."

So again, lacking district resources, Dewey looked for outside support. It found it at the University of Michigan, where researchers with a National Science Foundation grant were preparing to transplant a reform-based science-technology curriculum into urban schools. By 1997, Dewey was one of a handful of Detroit Public Schools to be selected for the program.

Dewey also got more aggressive in fund-raising: It raised $4,000 from local businesses and a few parents to purchase

A LIGHTHOUSE SCHOOL, continued

wiring on Net Day 1997. "The wiring went into the basement, for storage, but we knew someday, somehow, we were going to use it," says Parker.

By early 1998, they got their chance. After seeing Dewey's commitment to technology, and in the slow process of wiring its 264 schools, DPS officials agreed to wire Dewey if the school picked up half the $13,000 cost, Spann says. She and Parker, with help from a few volunteers such as a spouse's friend who worked for a computer company, wired the first six classrooms themselves.

"We were drilling, crawling, dropping wire, everything," Parker says.

In the meantime, Dewey had also obtained Title I money to hire a staff coordinator, who assists other teachers with improving instruction and using technology, and a computer lab teacher. Elementary teachers started holding their own technology workshops. By then, Dewey's tech confidence began to rise. "We had a chicken in every pot," recalls Spann. "We wanted a full meal."

Dewey told researchers at the University of Michigan that the school wanted more say in how its technology program developed. Plus, the University of Michigan's grant was focused only on middle school science classes. Spann and Parker wanted all their students involved. Both say it was a good lesson in learning how to deal with outside reformers — universities or foundations that often have their own priorities and requirements to meet.

"We very nicely said, 'We don't want tech driving us,'" says Spann. "We didn't want them to just come in and overlay their program. We wanted them to help us reach our goals."

The researchers agreed to open the workshops to all teachers. And rather than have computers in just the science classrooms, Dewey used its grant money to buy 13 laptops, thereby making them available to all teachers and easier to store nightly in a secure room. It also began offering free workshops for parent helpers. By early 1998, Dewey's technology program was on a roll.

Nowadays, Dewey has a full-time Macintosh lab open to all sixth- through eighth-graders, whom the school believes will most benefit from learning with technology. Its computer teacher, Carden, works with teachers who bring in their classes when appropriate to the curriculum. She also teaches five elective classes a week in word processing, graphic design, the Internet and Web design. These electives are for middle school students. She sends notes to homeroom teachers, asking what they'd like reinforced in her class, or she comes up with her own projects, some of which have included journalism, cartooning, Spanish and mathematics. She's also available to elementary teachers and after school for students.

Less than a handful of Detroit schools have such resource people who can assist teachers, yet researchers say they are key to schools' success with technology. On this day, for example, an eighth-grade science class visits Carden's classroom with its teacher, Toby Curry. Curry is on hand, but she's not familiar with the technology, so it's Carden who runs the class. With 22 students, two at each computer, the room is chaotic, as the students try to open the appropriate files. They raise hands and yell out questions only Carden can answer.

"What's a template?" one girl asks.

"How do you get 'Relationship Editor'?" a boy hollers.

Without Carden, the University of Michigan's program would be tough to put in place. Few teachers have her expertise.

In the air-quality project students are working on, the computers allow them to see the relationship between, say, air pollution and people who get cancer. The students analyze the relationships, then log the information into the computer, as it shows the cause-and-effect relationship through a diagram on the screen. Later, they'll test their models with further questions to see if the models hold up. Three other units — physics, weather and water quality — also are part of the curriculum.

The impact on students' learning and participation hasn't been documented in Detroit. This year, 3,000 Detroit students, including Dewey's, will be tested through written assignments, models, personal interviews, questionnaires and skill transfer tests.

Dewey has had to make choices as it's incorporated technology, including cutting a librarian's position to create Carden's. Indeed, Carden's classroom has become a miniature media-center. So many children want more access to books and magazines that Carden has brought in her own collection and checks them out to interested students.

But Carden says students gain by becoming comfortable with technology in the only place they have access to it: school. Few of her students have computers at home; many don't have phones. Some go on-line in the computer lab at the Jeffries housing projects across the street, where many students live. The lab was set up by DPS, with federal housing and other institutions; the district wants to set up six such centers in strategic areas around the city to give more Detroiters access. The Jeffries projects, however, are currently being torn down, so it's unclear where Dewey's students will go on-line in the future.

More teachers, inspired by their school access, have invested in home computers, says Spann. Five years ago, just a handful of teachers had them. Now, that number is about 40 percent.

Dewey's newest goals: to provide workshops for all parents and home-loan computers for all students and teachers, and to decide which technology skills children should have when they finish each grade.

"It's taken much longer than we expected to do what we've done," says Parker. "But we're getting there."

The View across the State

Few school districts will admit parents' interest in charter schools is driving them to change how they operate. But in the highly competitive environment Michigan's mostly urban schools increasingly face, they must.

Certainly Mt. Clemens has. With 40 percent of its students now enrolled in Edison programs, the district is offering new programs rather than have Edison "look . . . superior," says Jon Archibald, Mt. Clemens' assistant superintendent for business and operations. The district has added five high school Advanced Placement classes and a full-day kindergarten. It's also considering K–6 Spanish, which Edison offers.

"If Edison is even a little bit successful in something, the district looks at it," Archibald says. "And I think the whole district has risen because of that."

On technology, though, little has changed. Less than 10 percent of Mt. Clemens' teachers have had any training on using technology to bolster the curriculum, Archibald says. "If you walk into a lot of our schools, I don't think they'd look any differently than they did 10–15 years ago in terms of how they're using technology to teach."

Mt. Clemens is probably typical for Michigan in that way. In a 1997 study done for the state, the average Michigan teacher had less than 10 hours of technology training, says Jamey Fitzpatrick, who recently stepped down as the state Department of Education's director of technology services. The national average is about 15 hours, he says. The low percentage is partly due to a state law that says school districts can't use bond money — their major funding for technology — for teacher training. Technology supporters are lobbying to change the law.

The state's two largest universities, the University of Michigan and Michigan State University, have made educational technology a priority, however. The University of Michigan's Center for Highly Interactive Computing in Education has been developing curricula and software for eight years, and its science-based curriculum work is expected to receive funding from the National Science Foundation for several more years. Detroit's Wayne State University, meanwhile, is working on teacher training and connecting college students to Detroit's students as mentors through e-mail.

At Michigan State, educators are working on a federally funded program called Computer Klubhouse, which is designed to engage at-risk teens through technology after school and during summers and weekends. Detroit's Amelia Earhart Middle School is one of 10 urban or rural schools in the state that have been selected to become involved in 1999. "The theory is, forget technology, and let kids play and learn through their own interests," says Lawrence Stackpoole, Earhart's computer teacher. Students will have free access to the school's lab, games and the Internet with college students or trained peers to help them with questions.

Beyond such reform efforts and a few state grants, there are no statewide programs. In 1998 Michigan released a state technology plan that essentially offered guidelines to districts, such as providing parent computer training. In keeping with Michigan's tradition of strong local control, districts are figuring out for themselves how to invest in and use technology and whether it works.

So far, very few schools know how to use technology for learning, says Kellogg's Austin. The foundation has funded more than 250 schools in the state for technology access and use.

"When I go into the schools, I see a lot of very old equipment, not connected to the Internet, being used to play games," she says.

Judah L. Schwartz, professor of education at the Harvard University Graduate School of Education, says schools should not spend a dime on technology until teachers are trained, curriculums are reformed, educators know what software supports analytical learning and schools have the money to support every component of the program. That is unlikely, though. As districts nationwide rush to invest billions in technology, less than 5 percent of U.S. schools use curriculums that encourage analytical thinking.

"Why buy it if you don't know what you're going to do with it?" says Schwartz. "Would you buy a car to sit in your driveway? No. You would have a driver's license and know how to drive."

Statewide, too, the school that educators look to for proof that technology can work, if used with the right curriculum, is Ann Arbor's alternative Community High School. In 1991, years before most people knew what the Internet was, three science teachers, working with University of Michigan researchers, began developing a project-based science curriculum involving Web research that would integrate earth science, biology and chemistry in a single three-year class. The work was so rare that the students' Web site was among the first school sites nationwide.

Within one year, Community's ninth-graders improved their state standardized test scores from the state average of 35 percent to 75 percent. The school's students have maintained that level ever since.

Technology was important, but not the key in revamping the curriculum, says Mike Mouradian, a Community High teacher and a co-creator of the curriculum. The classes changed from lectures to inquiry-based projects in which the students led the learning. Other neighboring high schools mostly have stuck to the old-style program, and their average science test scores have remained considerably lower, at 52 percent.

"It's tough to do," Mouradian says. "It's absolutely giving up control. You're not the 'know-all' to everything. The kids do the research."

Today, the University of Michigan is working to transplant the work to 10 Detroit middle schools (including Dewey), which DPS leaders chose based on the schools' support for reform and their technology capacity. By fall 1999, the program is expected to

be in 20 middle schools, University of Michigan researchers said.

Making Daily Use of Computers

Other Detroit schools are also beginning to use technology in their daily lessons. At Earhart, students checked out 14,000 books — a massive jump from the school's usual 2,000 — in one school year when teachers began using a reading software program that tested students' comprehension immediately after reading. Fifty-eight percent of its students are Hispanic, many of whom come from immigrant families and struggle with verbal skills. So the jump sold Earhart's principal on investing in technology annually.

"We had more than 60 percent of students involved at one point," Stackpoole says. "If you've got that many kids involved in any one activity, it has to be a success."

Earhart's computer lab bulges with technology. One day last November, Stackpoole unpacked new iMacs from stiff boxes as his next class filed into the old home economics classroom. At Earhart, every sixth-grader must have at least one semester of computer basics. About 20 sixth-graders slouch their way to their desks, where a few dozen sparkling and relatively new Macs sit. In a few minutes they'll talk about their next assignment: creating a Web site on the history of their southwest Detroit neighborhood through family interviews, researching Detroit Historical Society documents and writing their own autobiographies. Resources are tighter at Dewey Learning Center, but computer teacher Carden has seen her slower learners particularly benefit from computer software that reinforces repetitive skills, such as math, or teaches students through storytelling. One eighth-grader, James, for example, started out in Carden's class four years ago with a D in math. He's maintained C's and B's since.

"I like the games," James said, as he played Yukon Trail, an adventure software program that uses judgment and math skills. The same day, other students played Number Heroes, a pattern-and-relationships game that grows harder as students master each level. One student played a Berenstein Bear conflict resolution game in Spanish to practice for his language class.

Carden uses a variety of software and comes up with her own projects, based on what students need to know for state standardized tests. She hasn't tracked the success of her students, about 60 percent of whom are at the lowest level, grade-wise, of their class. But she estimates about a third of her 70 students have improved their grades over the last three years.

For her master's thesis, in fact, Carden studied low-achieving third- through eighth-graders in Detroit's Cass Corridor to see whether math software improved their scores over the 1994-95 school year. Of 50 students, 97 percent who didn't show mastery of addition at the beginning of the year had greatly improved by the end. The numbers were similar for other areas: 86 percent for subtraction, 74 percent for multiplication and 70 percent for division. The more children practiced on a computer, the higher their end math scores were, Carden's research showed.

"The thing about a computer is, it's totally nonjudgmental," Carden says. "And it's individualized." It allows students to take risks without fearing public failure, she adds, and provides a slower pace and immediate feedback— all especially beneficial for slower and specialized learners.

Those are results that parents and others in the community want to see, especially with a high-cost reform like technology.

"It's a tough crowd," says Stackpoole. "It's gotta work, or they'll run you out of town."

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ASTRONOMY

③ CLEVELAND

Teaching the teachers

By Shari Sweeney

Laura Holzheimer knows what it's like to stare at a computer keyboard and be stymied. A veteran elementary teacher in the Cleveland Public Schools, Holzheimer still remembers being apprehensive about installing software on her laptop computer.

Today, though, as one of approximately 50 teacher trainers in the district, Holzheimer comfortably dispenses advice to a roomful of worried teachers, all with laptop computers and all first-time users.

"Remember, you learn the most by clicking, clicking, clicking," Holzheimer says. "Explore. Talk with a friend. It wasn't so long ago that I was scared to death."

Nationwide, technology experts advise school districts to spend at least 30 percent of their technology budget on teacher training if they want to make a difference in teaching and learning. Few districts come close to that percentage, though, and that shortfall shows in the way teachers react to using technology. An influential 1995 report from the federal Office of Technology Assessment, for example, reported that a majority of teachers describe themselves as inadequately trained to use computers and lacking confidence in their ability to integrate technology into the curriculum.

Figures from the National Center for Education Statistics (NCES) released in January 1999 also show how uneasy teachers are with technology. Although 78 percent of schools currently have access to the Internet, only 20 percent of teachers report feeling well prepared to integrate technology into classroom instruction.

Cleveland hopes to change some of those numbers. In the last three years, the district has seen an influx of 7,200 computers into its kindergarten through fourth-grade classrooms. The source of the hardware: Ohio's SchoolNet Plus program, which has pumped $430 million into the state's low-wealth school districts in the last three years.

CLEVELAND PUBLIC SCHOOLS	
Number of schools	118
Total enrollment	77,000
Demographics	
African American	70 %
Other	30 %
Free and reduced lunch	75 %

SOURCE: Cleveland Public Schools

In Cleveland's case, that's meant being able to put three new multimedia computers in every elementary school classroom plus provide teachers with their own laptop computers. In return, teachers have agreed to complete 60 hours of technology training in the next three years.

The result has been appreciable: Before SchoolNet, Cleveland had only a handful of schools using technology, most of them magnet schools and then mostly in computer labs. "There was nothing systemic, nothing sustained," says district technology director Paul Karlin. Today, every elementary school has computers in every classroom.

The ability to use that technology varies widely, though. The longer teachers have had their laptop computers, the more comfortable they've become using the technology in the classroom, says Karlin. Those who've just received their laptops have as little as four hours of training; others, who've had the machines since the program began, have completed 40 hours or more. Class use correlates with those numbers. "In classrooms where there's a high level of use, teachers have had their computers for a while," Karlin says.

On the Edge of Implosion

Karlin is among the first to concede: As in other urban school districts, the problem of teacher training looms large in Cleveland. At the elementary school level alone, Cleveland will be providing 60 hours of training for 80 schools in the next few years. This year, the district expects to spend $1 million on teacher training in technology, the same amount it spent last year.

But Cleveland's schools face a constellation of other challenges as well. More than 70 percent of the 77,000 children who attend Cleveland public schools receive some form of public assistance. In 1998, the district's high school graduation rate was approximately 40 percent — half the graduation rate statewide. At the elementary school level, where most of the district's teacher training on technology is taking place, test scores remain woefully low. According to figures from the district's Office of Research and Accountability, only 17 percent of Cleveland's fourth-graders pass all five sections of the state proficiency test vs. a statewide average of 38 percent. In addition, only 8 percent of the district's sixth-graders

CLEVELAND PUBLIC SCHOOLS

Student-to-computer ratio		
Elementary	8:1 (classroom)	8.5:1 (lab)
Middle	1,140:1 (classroom)	27:1 (lab)
High school	209:1 (classroom)	47:1 (lab)
Student-to-multimedia computer ratio		Same as above
Schools with a local-area network		56
Schools connected to a wide-area network		2
Schools connected to the Internet		2
Classrooms connected to the Internet		~ 300
Total number of classrooms		3,369

SOURCE: Cleveland Public Schools

pass all five sections of their state exam. In many schools, too, the issues of safety and security muscle out learning to teach with technology.

For years, too, the district has teetered on the edge of implosion. Throughout the 1980s, the district struggled with a legacy of racism and discrimination that branded Cleveland as one of the most segregated school systems in the nation, and the district has yet to be released from court oversight. In 1995, too, a federal judge ordered the state to takeover the district, which was $155 million in debt and academically bankrupt.

Last fall, then-Gov. George V. Voinovich returned control of the district to Mayor Michael R. White and a nine-member appointed school board. The district's new chief executive officer, Barbara Byrd-Bennett, who joined the district just before Thanksgiving last year, has a track record of working successfully with low-achieving schools in New York City, boosting reading and math scores, improving facilities and decreasing student suspensions. It's unclear how technology will fit into her plans for the school system though she has pledged to use remedial software to help high school students get up to speed on the basics.

Currently, too, the district's technology framework calls for the district to invest $75 million of its own funds to put more computers in schools. Seventy-nine percent of Cleveland's classrooms have computers. But while SchoolNet Plus funds have given elementary schools a student-to-computer ratio of 8:1, the lack of funding at the middle and high school levels has resulted in dramatically higher ratios of 1,410:1 and 209:1 respectively in the city's classrooms and 27:1 and 47:1 in its labs. That often means long waits for computers, overcrowded computer labs and marginal use of technology in many of the city's middle schools and high schools.

To close that gap, Karlin estimates the district will need 1,300 computers at the middle school level and 1,575 more for high schools. As of March 1999, though, the framework had yet to be approved by the district's financial oversight committee.

Another concern is aging buildings. Problems range from patches of missing floor tiles in hallways to roofs leaking so badly that classrooms are temporarily closed off and cheap box fans are used as makeshift dryers. In many classrooms, acoustic ceiling tiles that are not stained from water damage are often missing altogether, revealing corrugated steel roofing above. Even glass-block windows meant to protect building occupants are often cracked or smashed, patched with plywood that has been there so long that it is weathered to silvery-gray.

A 1992 survey by the Ohio Department of Education in fact estimated that it could take $500 million to make the district's schools comply with building codes. For technology, the challenge is clear and costly. Karlin estimates that electrical upgrades alone could cost between $20,000 and $500,000 per school. In some cases, such updates might involve adding extra circuits; in others, new power rooms might be needed. Finding spaces for routers and other networking equipment is also an issue in overcrowded and aging schools.

Tim Best, director of programs for the SchoolNet Commission, the state agency that oversees SchoolNet funds, lists other concerns. Many of Ohio's oldest schools have problems with asbestos. Many times, too, schools are so old that blueprints have been lost, making renovations difficult, Best says.

In Cleveland, as in other urban districts, technology has to compete with such needs. The district received $25.6 million in E-rate discounts this year. But it's not clear how much — if any — of those savings on telecommunications and Internet services will be re-invested in technology. "One day the check will come in, and we'll make the case that it should come back to education technology," says Karlin. "But at the same time, someone could say that there's a roof broken somewhere and that money will be gone."

That leaves the district piecing together funds from grants and other federal monies. "It's piecemeal. It's hit-or-miss," says Karlin. "We go after the big grants, and we go after the not-so-big ones." The district does not currently support technology with its own funds.

With state and local officials calling for greater accountability, the pressure to teach to the test and avoid reconstitution also affects whether technology becomes accepted. "A lot of teachers worry that they need to get proficiency scores up in two years, or they will be gone," says Harold Johnson, a professor at Kent State University. "They are being taught to do what is safe. But technology is not safe. It is about taking risks."

Until this year, too, Cleveland lacked any kind of telecommunications infrastructure. At the end of 1998, only 300 of the district's 3,000 classrooms had a connection to the Internet, and those connections were by dial-up modem rather than high-speed lines. That could change dramatically this spring when the district receives its first round of E-rate funds. Until those funds appear, though, few schools will have regular Internet access.

These hurdles — the pressure to do well on proficiency tests, the lack of Internet access, the challenge of creating a cadre of teachers who can change teaching and learning — are all apparent at the school level.

Computers Do Many Things: Miles Park Elementary

It's easy to overlook Miles Park Elementary School. Its appearance is nondescript, and several letters on the side of the building fell off so long ago that not even their shadows remain on the blond brick. The sign now reads, simply, "S PARK."

On the door of the teachers' lounge, someone has taped a cartoon from the *Cleveland Plain Dealer*. In it, former-Gov. Voinovich (now Sen. Voinovich) announces that "to solve the school funding crisis, I call for each House and Senate member to sell 12 boxes of candy bars, almond or crunchy."

But just down the hall, students use computers to test their reading comprehension skills and to help them select books that are appropriate for their reading levels. In addition to its 27-terminal computer laboratory, the school maintains three computers in every classroom and laptops for every teacher, most acquired within the last two years with SchoolNet funds.

On this, the first day back for Miles Park's 500 students after several snow days, second-grade teacher Jane Rodgers moves around the bright computer lab, built and outfitted about three years ago using Title I funds. A local contractor also donated his time.

Three walls are lined with IBM workstations, with another half-dozen or so computers on an island in the center of the room. In one corner is a central server to which all machines are networked, and where each student's work is recorded according to a number students type into their computers before beginning a lesson. Each workstation is also equipped with headphones through which audio instructions are fed.

Today, students are working on math skills. Sylvia, a slight girl with beaded, braided hair that clacks softly when she moves, uses a pull-down menu to locate a ruler, which she uses to measure the height of a box of paper clips pictured on her computer monitor. Across the room, students puzzle over story problems that involve selecting the one bar graph out of three showing that "Marilyn planted more beans than Brian." Each student is graded only on how he or she does on that day's work. Those grades are reflected as numerical averages, a percentage of a grade that will also include homework and tests.

The software is part of an integrated learning system (ILS) into which Miles Park has clearly bought. ILSs employ a drill-and-practice approach that many researchers have criticized for its emphasis on short-term improvements — such as those needed to do well on state proficiency tests — rather than long-term academic gains. But Principal William J. Bauer says the system is only part of his school's overall technology plan.

"We don't rely on one thing," Bauer says. "That's one of the problems [with using technology] in schools. Some people . . . forget everything else, like overhead projectors and problem solving and manipulatives. You have to have a multitude of approaches."

In addition to the ILS, Miles Park has two full-time faculty members whose job descriptions include teacher training. One is the computer lab supervisor, Janice Justice; the other is Justice's science lab counterpart, Matthew Teare. Both team-teach with their colleagues. Justice instructs teachers on the use of the ILS software (including how to keep track of how well students are doing) as well as other educational programs; Teare demonstrates how to use laser disc images to enhance a lesson.

Computers here are used for different tasks. The tests students take to determine their reading levels, for example, are given in the lab, where 27 students can work simultaneously. Reports are typed on computers in the classrooms while other students work at their desks.

In an English class, for instance, youngsters scribble stories on notebook paper about the icy weather that gave them all a few days off from school. Students take turns typing their stories using a word-processing program. The printouts are then glued to colored construction paper.

Jason writes a story titled "The Big Snow Storm," which opens: "Hi, my name is Jason. I am 9 years old. I am 4 feet tall. I am short. I was born in 1989." Jason's spelling is perfect, though his understanding of plot is a tad weak. Beside him, a teacher helps another student but is interrupted by the noise behind her. Children are standing in clumps between desks, talking and laughing with their classmates.

"I should not hear any talking," the teacher says as the class quiets down. "If you're not typing your story, you should be reading at your desks."

Downstairs in the science lab — a room filled with antlers, aquariums and papery sections of wasp nests — Teare is talking with second-grade students about inclined planes. Using a wand that looks like a TV remote-control device but functions like a supermarket checkout scanner, Teare chooses photographs of ski slopes and wheelchair ramps from a laser disc catalog. He shows a short "movie" of cars inching down San Francisco's Lombard Street — "the crookedest street in the world" — to demonstrate how ramps help slow vehicles and make roads safe.

The laser disc packages Teare uses consist of a disc, notebooks of bar codes with descriptions of the pictures and a scanner. When the scanner is swept across the code of the desired image and then pointed at the laser disc player, the image the teacher has selected appears on the monitor. Sometimes, Teare says, teachers make copies of pertinent pages, then cut-and-paste the bar codes directly into lesson plans, eliminating the need for Post-Its on every other page or frantic flipping during class.

Schools like Miles Park are seeking additional funding — from the district, the state or federal government, anyplace they can — to link computers

between schools and to the Internet. Bauer is also working on a project that will link his school's computer lab with the Salvation Army shelter across the street, so students who live in the neighborhood and do not have computers at home will have access to PCs.

But keeping the learning curve from becoming too treacherous might be a tall order, despite Bauer's good intentions and his teachers' enthusiasm. By mid-winter, more than a third of the student body had transferred in or out of this school — 200 of a total of 500 students were transfers, most from other poor, urban schools. Further, while the percentage of Miles Park's fourth-graders that pass all five sections of the state's proficiency test is higher than the district average, it is still quite low. The district average, according to the Office of Research and Accountability, is 17 percent. Miles Park's average is 21 percent.

Working Closely with Teachers: Joseph F. Landis Elementary

In another corner of the city, just blocks from the Cleveland Museum of Art and Severance Hall, home of the world-renowned Cleveland Orchestra, Joseph F. Landis Elementary uses technology differently. Its computers, though, were acquired in much the same way as other Cleveland schools have acquired them — which is to say, any way teachers and administrators could.

Principal James Balotta and several teachers developed the plan for their school's computer lab. SchoolNet and SchoolNet Plus provided funds for three terminals and one printer per classroom, and in spring 1998, the district's magnet schools office funded the purchase of two dozen PCs for Landis's computer lab. In all, there are 120 computers scattered throughout the building for use by just under 500 students.

The PCs in the computer lab are the only computers in the school that are networked. None are connected to the Internet, although wiring is in place for that purpose. Balotta says all he needs is a server, and though he has no idea when it will be installed, he has a good idea how Internet access will be used: "Teachers will use it for enhancing lessons and students will use it to write papers and for research."

Holzheimer, a former reading and English teacher, runs the school's computer lab with Pat Coleman Segedi. Holzheimer teaches computer use to grades three through five all day, three days a week, and on the other two days makes repairs and upgrades to computers throughout the building. Segedi takes care of "the babies," she says — the kindergartners, first- and second-graders. As at Miles Park, the two computer teachers work closely with the school's other teachers.

Holzheimer and Segedi agree it's been difficult, first finding money for computers and software, then teaching themselves entirely new skills. "I'm a teacher," Holzheimer says. "I never learned how to troubleshoot computers. Every time someone came in [to fix something], I sat next to them and kept asking questions."

Another difficulty: Since opening the computer lab and outfitting classrooms with PCs, Landis has also been broken into more than a half-dozen times, resulting in the theft of 10 computers in less than a year. Balotta says a new security system — for which wiring was laid just after the Christmas break — should offer better protection.

On a more positive note, in early February, Landis was invited to participate in Alliance Plus, a program through which groups of teachers and administrators will be trained to use the Internet in the classroom, then sent out to teach their colleagues the same skills.

"There are perks for participating schools," Balotta says, chiefly the fact that all teachers who complete Alliance Plus training will receive modems for their school-issued laptop computers. Landis will also have its own Web site linked to the board of education's site and the sites of other Cleveland schools.

Right now, though, Landis's computer lab serves far more basic purposes. The lab itself is a small classroom with a great deal of extra wiring, most encased in narrow floor-to-ceiling columns in the center of the room. Third-, fourth- and fifth-graders spend two back-to-back 40-minute periods here every week. Younger students spend one class period per week here.

On an unseasonably temperate midwinter morning, about 20 fourth-graders are studying the Maurice Sendak poem "January." They read the poem aloud — "In January, it's very nice . . . to sip chicken soup with rice," and so on — and are then instructed to type the poem into their computers. The students' hunt-and-peck typing is excruciatingly slow — most catch and correct misspellings as they go.

Later, Holzheimer walks the class through the process of highlighting a word and changing its style, font and color. She talks about using a cursor to move to the top of a document, saving a file to a disk and figuring out whether the A: drive is working. Before they center the poem's title at the top of the page, Holzheimer has the students read aloud the choices under the text menu. "Choose fonts," they chant. "Set alignment." "Insert bullets."

Classroom teachers ostensibly team-teach with Holzheimer and Segedi, though how they work — observing or participating — is an individual matter dependent on the teacher's own comfort level with the computer and whether the lesson in the lab relates to classroom work. (Teachers admit: The two don't always relate.)

CLEVELAND PUBLIC SCHOOLS

Percentage of computers at grade levels	
High school	9 %
Junior high/middle school	9 %
Elementary school	82 %
Location of computers	
Computer laboratories	18 %
Classrooms	79 %
Media centers/libraries	3 %

SOURCE: Cleveland Public Schools

Fourth-grade teacher Margie Bodle spends most of her time one morning on troubleshooting — helping one student move his cursor or another find a button on the tool bar. Later, another fourth-grade teacher spends time leaning over students' shoulders, clearly searching for something she does not know where to find. There is a brief moment of panic when the computer screen freezes and Holzheimer must come to the rescue.

How lab activities mesh with classroom work is also an individual matter. There are no school or district guidelines as to how often computers should be used or what applications should be taught.

First-grade teacher Diane Kapostasy does her best to cover the same types of lessons her students receive in the computer lab. If they are working on typing skills, for instance, Kapostasy might have them write stories on the three terminals in her classroom.

She admits, though, that first-graders' test scores aren't scrutinized as closely as the scores of students in other grades. So she feels less pressure than other teachers do to use computers to cover the same content the tests do. Other teachers find that the pressure to prepare for proficiency tests while also learning to use technology is too great; there's little opportunity to work on integrating computers into classroom work, they say.

"We're working on proficiency from August on," Bodle says. "We don't have time to get kids on computers all the time."

Forty-percent of Landis' fourth-graders, though, pass all five sections of the state proficiency test, the second-highest percentage in the district.

At the same time, teachers note, the school has only had computers in classrooms for two years. Many say it took them almost an entire year to overcome their computer-related fears, much less think about how technology can be used in the classroom.

"I was so afraid I'd break something," says Penny Levine, a second-grade teacher who is now familiar enough with computers to wish aloud that the school would purchase more software. As it is, she says, she's continually borrowing the math and science programs her students love from other teachers.

Normally, Levine's 25 students work on the PCs in groups of six for 15-minute stretches, as marked by a kitchen timer. Today, though, the teacher could not get the math program she wanted, so students are instead sitting at their desks, using pencil and paper to study number families (4 plus 3 equals 7; 7 minus 4 equals 3; and so on). Would they do this on the computer if they could? Sure, Levine says, though had she been able to place groups at the PCs, she would have assigned the number families as homework instead.

While teachers say they understand the need to introduce technology to youngsters, many also admit that at this early stage in their own technology education, use of computers in the classroom remains segmented: Do this at your desk, and that at the computer.

"Teachers are still learning about the programs," Balotta says. "They're still learning how to incorporate those programs in their lessons. I can see [the integration] at the beginning levels."

CLEVELAND PUBLIC SCHOOLS

Total annual technology budget	$8.2 million
Source of technology funding	
Local operating budget	0
Federal funds	$400,000
Grants	$7.8 million

SOURCE: Cleveland Public Schools

Teachers Push for Technology: East High School

If elementary schools are Cleveland's leading edge, high schools are the district's periphery. Without the basic hardware — high schools haven't been the recipients of SchoolNet technology funds — little goes on in the way of technology use, Karlin concedes.

One exception is East High School, where teachers have aggressively gone after technology on their own. Virtually every one of the PCs in the building, from ancient 286s to speedy Pentiums, was secured through corporate donations and installed by teachers who for the most part taught themselves about technology.

Currently, East High has more than 300 Windows-capable computers for approximately 1,200 students. Computers that are not in lab settings are scattered throughout the building, their placement based on teacher and departmental requests. Some classrooms have two or three workstations and others, either by choice or because they are awaiting answers and requests, have none.

The donated machines are stored in Paul Lockhart's physics classroom, where several lab tables are crowded with computer parts — blank monitors at odd angles, tower-style CPUs lined up like oversized library books. Lockhart, who is also head of the school's science department, repairs the PCs, sometimes patching together parts from several computers to create a single working machine.

The security at East High is tight: Computer labs — there are, essentially, two, one for general use and another for a special business administration program — are outfitted with hefty alarm systems and are kept locked 24 hours a day. It's virtually impossible to tell where the computers are: The narrow, wire-reinforced windows on most classroom doors are covered to prevent anyone from seeing inside. Even the exterior windows to the main computer lab — the glass is already frosted — are covered with paper in the school's colors of blue and gold.

As at virtually every Cleveland public school, computers are bolted down and moving parts, such as CD-ROM drives, have been removed. When students work on CDs, the disks are loaded in a locked tower-style drive to which all computers are connected.

Lockhart, who taught himself to write HTML code, pulls pages from

RAISING THE BAR: TECHNOLOGY IN MIDDLE SCHOOLS

After pumping millions into elementary schools statewide, Ohio is slowly turning its attention to middle schools. Specifically, in 1997 Ohio received a five-year, $42 million federal grant from the federal Technology Literacy Challenge Fund, which helped Ohio SchoolNet and the Ohio Department of Education develop a program known as Raising the Bar in the Middle Grades. That program awards up to $375,000 to individual middle schools to integrate educational technology into the classroom. The goal: to create models of how technology can be used at the middle school level.

Grant recipients use funds to purchase software and hardware, to finance professional development and to acquire Internet access. Since the program's inception, Raising the Bar has funded more than 60 projects throughout Ohio. About 200 schools applied in the first round, and well over 300 applied in the second.

Grants are awarded only at the building level, with a school's poverty level accounting for 30 percent of each applicant's score. SchoolNet is currently reviewing applications for the third round of Raising the Bar grants and expects to make about 30 grants later this year.

Cleveland's **Albert B. Hart Middle School** was a second-round grant recipient in February 1998. A partner with Miles Park Elementary in a program to help ease the transition from elementary to middle school, A.B. Hart's use of technology at first appears to mirror that at Miles Park.

Example: As part of a schoolwide emphasis on literacy, students at A.B. Hart also use an Accelerated Reader program to help choose appropriate books (and ultimately, it is hoped, to raise reading proficiency scores). The school's computer lab also has integrated learning system software similar to that at Miles Park.

But A.B. Hart — academic home to about 1,000 sixth-, seventh- and eighth-graders, the vast majority of whom come from low-income households on Cleveland's southeast side — goes further, in large part thanks to its selection as a Raising the Bar school.

The school has more than 100 computers and is awaiting delivery of another 75, purchased with Raising the Bar funds. It also operates two computer labs, one IBM- and the other Macintosh-based, each with about 30 workstations. NASA has provided A.B. Hart with one ISDN line to which a Web TV set was recently hooked up.

According to A.B. Hart computer resources teacher Nancy Toth, about 30 of the school's 47 teachers currently have — and, she says, use — laptop computers for everything from tracking grades to typing lesson plans. Though Toth and an aide run the labs and oversee use of ILS-related software, Toth says teachers are for the most part responsible for working with students in the IBM lab and teaching computer-use skills like word processing.

Thanks to Raising the Bar, teachers also have access to extensive training — Toth says most have completed at least half of the 80 available hours. Faculty members who complete the training receive a laptop computer they can use so long as they teach at the school.

As for integrating technology into the curriculum, A.B. Hart's Raising the Bar program, called "Exploring Our Roots and Beyond," uses everything from the Internet to digital cameras and is split into three distinct segments.

The sixth-grade segment applies computer technology to the Selborne Project, an interdisciplinary middle school program, available nationwide, in which students study a square kilometer around their schools, recording data on everything from plant life to neighborhood history, and producing maps, field guides and research papers. Data are reported back to the Roger Tory Peterson Institute of Natural History in Jamestown, N.Y. Participating schools — which include schools in Buffalo, New York City and Louisville, Ky. — commit an interdisciplinary teaching team to the two-year process, which includes 60 hours of training in nature study and team planning.

Computers are not specifically mentioned among any of the Selborne Project's listed objectives. Their use for research, word processing and graphing is a separate application conceived by the school, Toth says.

Seventh-graders, on the other hand, study African, Asian and European history. As part of their studies, they do research using Internet search engines, download files and create documents using programs like PowerPoint and HyperStudio. In eighth grade, the program winds up with students investigating — primarily on the Internet — careers in which they are interested. By June 2000, A. B. Hart hopes that 90 percent of its students will use some type of technology every day. (The percentage is currently about 40 percent.)

By contrast, **Collinwood CompuTech** — a Cleveland magnet school focused on computers and technology — is using its Raising the Bar grant for extensive study in space science. In 1998, Collinwood CompuTech was one of 11 U.S. schools chosen to participate in NASA's KidSat program, which allows students to observe the Earth through cameras mounted on space shuttles. Collinwood students work in teams and study such things as how lack of gravity affects the body.

the Internet on his home computer and adapts them for use on the 11 PCs in his classroom. One lesson shows an animated graphic of a see-through train car with two people on bunk beds inside. The person on the top bunk is dropping a grape toward the other's open mouth. Students can vary the speed at which the train travels to see whether the grape can still hit its target.

The computers have been useful, Lockhart says, for data entry and graphing — examining the correlation between the width of tree rings and annual precipitation. To do such tasks longhand would be too time-consuming, not to mention virtually useless in either the state proficiency tests and in real life. "Nowhere on the tests do you have to make a graph," Lockhart says. Computer technology cuts down on the busywork that in the past took time away from true test preparation.

Computers are "rotated" out of Lockhart's room — once he checks out and, if necessary, repairs PCs, they are moved to classrooms requesting them. Most of the 386s Lockhart used during the 1997–98 school year, for instance, are now in a biology lab. Older 286s have been moved to a variety of departments, including English and math, and brand-new Pentium-equipped PCs were installed in Diane Durr's Academy Tech classroom last summer.

A half-dozen young women work intently at Pentium computers in Durr's classroom. Until the 1998–99 school year, Durr had taught her mostly female students to type business letters and format resumes using WordPerfect 5.1 loaded onto 286 PCs.

Durr recently completed an eight-week, district-sponsored course on Windows 95 and Microsoft Office 97 — how to use the programs, primarily, with some teaching tips — in which she learned many of the same skills her students will. That course, Durr says, is the only training she has received through the district. "The rest is trial and error," she admits.

Durr, who teaches two sections of between 15 to 25 students each, admits that the faster Pentium machines and new software have made teaching challenging, if only because she is not nearly as comfortable with Microsoft Word as she was with WordPerfect. "I had taught WordPerfect for so many years that I knew it inside and out," Durr says. "This year, being the first year I've taught Office 97, it's like I have to keep ahead and do everything they're doing first to make sure it works like I say it will."

Academy Tech, funded in large part by KeyCorp, a Cleveland-based bank, prepares students for administrative and managerial jobs in the financial industry — jobs that do not require a college degree. In fact, KeyCorp has promised to provide entry-level jobs for every qualified graduate of the program.

Using Office 97, Durr's students work independently on assignments such as basic keyboarding skills and setting up reports and memorandums. A current assignment, Durr says, is to design their own letterhead on which business letters will be formatted and printed.

KeyCorp also provided computers for the Universal Lab, East High's main computer classroom. Rockwell Automation donated money and provided engineers to wire the lab, which the school estimates is used by more than 300 students every week.

The lab's 25 PCs are networked to a printer and central server. Greg Grys, a math teacher who has also become a computer expert, runs the lab and is in perpetual motion most days, pacing the periphery of the narrow room, looking over shoulders, checking the dot matrix printer that is almost constantly chattering.

Every one of the computers is in use this morning. Several seniors are typing research papers. Ildiko Balatoni's special education students, who are enrolled in a hospitality services vocational program, are inputting recipes for Best-Ever Orange Cake, spaghetti, macaroni and cheese.

Balatoni is an example of the enthusiastic faculty reaction to technology. After decades as a home economics and special education teacher, Balatoni says she recognized the need to move forward. "I'd never had a computer, but I thought it was time for me to learn," Balatoni says.

She says that her students — teens who function at a first- to third-grade level — often cannot read their own handwriting. Teaching them to type not only provides them with more marketable skills, but prevents cooking mishaps.

Outside the lab, teachers with computer-equipped classrooms are left to their own devices. Lockhart simulates experiments and sets up graphing software. The students in Grys's lab make liberal use of word-processing software. Language teachers use interactive CD-ROMs to build Spanish or French vocabulary.

"Availability is key," says Alexis Fell, a special education teacher who has actively sought technology for the school and talks of using the Internet and integrating Web-based research into her students' daily work.

As with other schools in Cleveland, though, no one is sure when East High will get that access or when technology will change teaching and learning.

"Right now, a lot of what [I do on computers] is what I was teaching before, but using computers. Some are things I was never able to teach before," says Lockhart.

And like other teachers in the district, Lockhart says the reality of high-stakes state testing cannot be ignored. "Ultimately, the state has decided that this is what they want kids to learn, so that's what we're going to teach," the high school teacher says.

In Cleveland, as in other districts, that could be the biggest challenge for teachers and technology.

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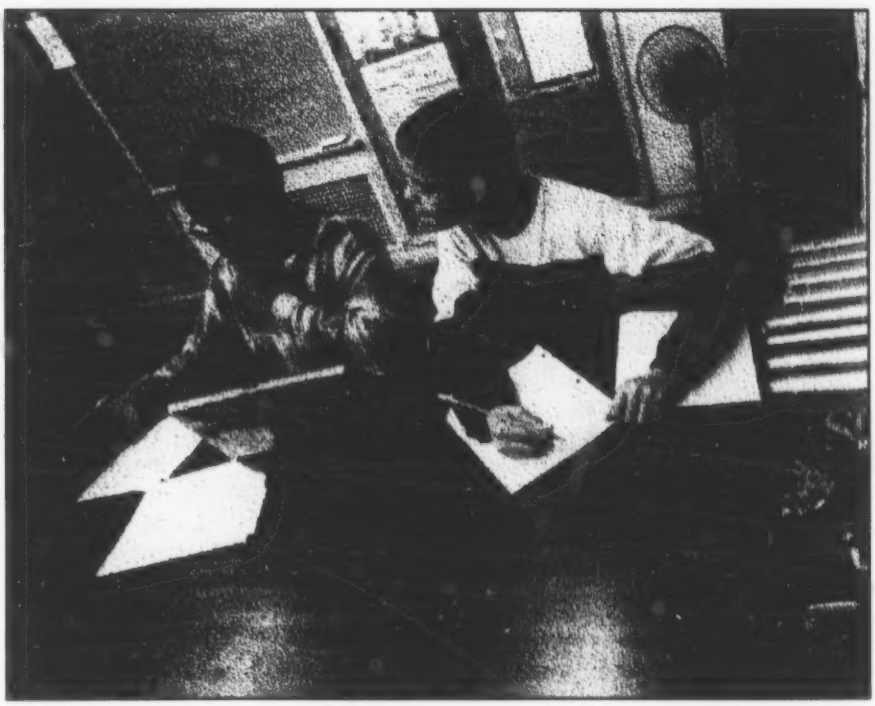
With reporting by Catherine Gilfether.



❹ MILWAUKEE

Promises of a computer on every teacher's desk and fiber-optic to the door

By Priscilla Pardini

It's 8:15 a.m. Monday at Hi-Mount Community Elementary School on Milwaukee's west side — time for morning announcements. Fifth-graders are at the microphone with information about Columbus Day, parent-teacher conferences and a school rummage sale. They lead the Pledge of Allegiance and read the lunch menu, featuring Milwaukee bratwurst.

But at Hi-Mount, students and staff don't just listen to announcements over a public-address system. That's because the announcements here come in the form of the Hi-Mount Morning News. On television monitors in each classroom, students watch the live, near-broadcast-quality program originating from the school's second-floor television studio, better known as the distance learning lab.

Meanwhile, across town at A. E. Burdick Elementary School on the city's south side, a group of sixth-graders excitedly elbow their way into the city's first "digital classroom." Long rows of silvery iMac computers sit on top of specially designed computer tables, creating an image that seems out of place in the 73-year-old red-brick building. Within minutes, the students have logged on to the computers, accessed the Internet and begun downloading text and graphics for a social studies project. They will spend half of their day here, five days a week.

Hi-Mount and Burdick are ahead of the curve when it comes to integrating technology into the classroom. But throughout Milwaukee Public Schools, an ambitious vision of technology is beginning to take hold. It addresses access and equity, teacher training and student data management, partnerships with businesses and higher education. And at its center, it embraces the idea of technology as a tool of school reform, deeply integrated into all aspects of day-to-day teaching and learning.

MILWAUKEE PUBLIC SCHOOLS	
Number of schools	154
Total enrollment	99,495
Demographics	
African American	61.5 %
White	17.6 %
Hispanic	13.1 %
Asian/Pacific Islander	4.9 %
American Indian	1 %
Other	1.6 %
Free and reduced lunch	80 %

SOURCE: Milwaukee Public Schools

A Vision of Technology

Whether Milwaukee manages to put this plan in place on a scale large enough to make a difference for the majority of its nearly 100,000 students remains to be seen. And few downplay the challenge the district faces.

"You've got a school system that is heavily impacted with low-income minorities, that still remains racially isolated, and has a history of not responding very well to the academic and social needs of those children," says Larry Cuban, professor of education at Stanford University. Going beyond the lighthouse schools — the handful of schools like Hi-Mount and Burdick that have already made technology work — will be difficult. In fact, Cuban says, no urban school district has made such a transition.

Henry Kepner, a professor of mathematics education and associate dean in the School of Education at the University of Wisconsin at Milwaukee, agrees. "No large district has found a way to have all its buildings marching in unison," he says. "It's the biggest issue in all of urban school reform, and not just in terms of technology."

Ten years ago, in fact, after decades of dismal student performance, Milwaukee gave birth to the nation's school choice movement. Further eroding support for the public schools are Gov. Tommy Thompson's periodic threats to "take over" the city schools, Mayor John Norquist's strong endorsement of private and public school choice and a politically contentious and frequently ineffective school board.

Already, the district has put some of its vision of technology in place. Last fall, the school system opened a new $2.25 million state-of-the-art technology training and support center featuring four computer labs, a videoconferencing lab and three seminar rooms designed to provide

hands-on training to 60 teachers at a time. Paid for with district money and manned by a staff of 13, the center also houses the district's technology help desk, which is set up to trouble-shoot problems with the district's 15,000 computers. In all, the district employs the equivalent of one full-time technology support person for every 2.5 schools.

At the same time, the district has adopted a student records management system that helps with routine tasks such as maintaining class lists, taking attendance, recording grades and filling out report cards. The system, which will be accessed through workstations on each teacher's desk, can also be used to track students' academic progress — individually, by school or districtwide. The system is now being piloted in 12 schools and is slated to be in every school by June 2001.

The school system also provides free e-mail and Internet access for each of the district's 8,000 teachers and approximately 17,000 of its students. Staff accounts are unrestricted; student accounts, subject to parent approval and adherence to the district's acceptable use policy, allow filtered access to the Internet.

Finally, the district's strategic plan for technology — the Blueprint that ties these and other initiatives together — calls for spending $275 million by January 2002. Nearly one-third of the money — much of it spent over the next 12 months — will go to construct a wide-area network connecting each of the district's 156 buildings with fiber-optic communication lines capable of delivering data, voice and video, as well as local-area networks connecting every office or classroom in each building. Ultimately, wiring in each of the district's more than 5,000 classrooms will support nine networked computers, a printer, a television and a multimedia teacher workstation.

A 2:1 Ratio at Hi-Mount

As the sun of a warm November day streams through the windows of their second-grade classroom, two Hi-Mount students sit knee-to-knee scrutinizing each other's computer-generated rough drafts. "I don't get that," says one little girl, squinting and pointing at a sentence on her partner's paper. "Let me see," says the author as she rereads what she's written.

Throughout the room students are being taught to review each other's work for faulty logic and missing information as well as for spelling and punctuation. It's a critical step in the writing process as taught at Hi-Mount: write a rough draft, conference with a friend, conference with a teacher, produce a final draft, publish a finished piece.

As part of the process, students move to and from the 12 PCs that line the walls of their classroom. They type up and print out their drafts and later return to edit out errors, add new information, change wording and save the final version to a hard disk. One boy's mundane story about brushing his teeth with his dad is expanded and injected with humor when his partner asks, "Did the toothpaste spray out?" It did — much to his father's chagrin.

The process exemplifies the most notable thing about technology at Hi-Mount: The computers are pretty much taken for granted and viewed as just one more learning tool. There are so many computers at the school — generally 12 in every classroom — that access is not an issue.

At Hi-Mount, pupils use their computers the way adults do: They do research (guided by their teachers) over the Internet or with CD-ROM reference materials, and then use the information they've gathered to produce a report, graph or spreadsheet. For a project on World War II, pupils went on the Internet to interview a woman who had been living in Hiroshima when the atomic bomb was dropped. For a unit on the early explorers, pupils viewed a CD-ROM presentation featuring an actor playing Christopher Columbus.

But even with technology so readily available, teachers continue to rely as well on a myriad of more traditional lesson plans. Fourth-graders, for example, still construct salt maps of Wisconsin. "But what a difference from the days when everyone in the class needed the same volume of the encyclopedia — the W — at the very same time," says Elise Riepenhoff, Hi-Mount's curriculum coordinator. "Now, they just go to the computer. It's a matter of having the technology support the curriculum."

In some cases, that also means using computers for rote learning. For example, a math lesson might call for a teacher to introduce the concept of counting by 10s to her whole class, and then divide the class into two groups so students can practice what they've just learned. Half work with manipulative materials — wooden blocks, marbles or play money — while the other half practice on the computer with software designed to tell the pupils when they make a mistake. After a few minutes, the two groups switch.

MILWAUKEE PUBLIC SCHOOLS

Student-to-computer ratio	10:1
Student-to-multimedia computer ratio	20:1
Schools with a local-area network	14
Schools connected to a wide-area network	50 %
Schools connected to the Internet (but many with dial-up access)	All
Classrooms connected to the Internet	1,000
Total number of classrooms	5,000
Type of Internet connection	
Dial-up access	Most schools
ISDN	Just a few
T1	60 or more
T3 (used exclusively for interactive video)	~ 9

SOURCE: Milwaukee Public Schools

DISTANCE LEARNING: CROSSTOWN CALCULUS

It's second period at **Milwaukee's Washington High School,** and Dennis Rashka is teaching Advanced Placement calculus. The lesson is on derivatives, the slope of a curve at a particular point on that curve. "Are you with me?" Rashka asks the six students sitting in front of him in the classroom as well as the two additional students whose images appear on an oversized television screen set up at the back of the room.

The two girls are students at **Marshall High School,** located about 3.5 miles northwest of Washington. Because there aren't enough students at Marshall to warrant offering AP calculus there, and the logistics of actually traveling to Washington too cumbersome to overcome, the students are taking the course via distance learning at Washington.

Rashka teaches the class in Washington's full-motion, two-way interactive video studio, one of seven in the Milwaukee Public Schools. The Marshall students hear and see everything Rashka says and does, thanks to the two cameras and microphone set up in the room. One camera is focused on Rashka; the other is a document camera focused on the long, complex equations the teacher writes out to illustrate the lesson.

"It's important that all the students at all the sites be able to see the lesson in the same way," explains Joe Kmoch, Washington's technology coordinator.

Rashka and the Washington students see and hear everything that goes on in the Marshall classroom, too. This morning, that includes listening to Marshall's morning announcements, which are being piped over that school's public address system. Rashka also occasionally visits the students at Marshall and works closely with a math teacher at Marshall who helps run the course.

Interactive video technology is also being used to connect students and teachers at the School of Education at the University of Wisconsin in Madison with MPS classrooms. UW students, for example, have been able to observe an experienced teacher at **Hi-Mount Elementary School** working with her class of first-graders. Following the demonstration, the college students and the teacher talk about what they observed. Such interactions, say district officials, could encourage more teachers-in-training to consider working in urban schools. The technology has also been used to allow UW professors to observe student teachers working in MPS classrooms without traveling the 150 miles between Madison and Milwaukee.

Schools with distance learning labs throughout the city and across the state also broadcast special programs to each other. The programs can range from a simple reading or social studies lesson taught by a master teacher to a special presentation by a local author or expert in a specific field. The technology can also be used to broadcast within a single school. A science specialist, for example, could demonstrate an experiment with one group of students while some or all of the others in the school watched. Individual teachers could then conduct follow-up discussions with their own pupils.

For Kmoch, the benefits are clear: "This is a great way to be able to expand a school's course offerings."

Though so-called "drill-and-kill" software isn't the most sophisticated use of computer technology, Riepenhoff acknowledges unapologetically that the school uses it. "At the elementary level, we are teaching lots of basic skills — things you just have to memorize, and computers can be very good at helping you do that," she says.

As for the teachers, they have computers on their desks to take attendance, figure daily lunch counts, print out lunch tickets, record grades and prepare report cards. With a click of the mouse, they're on the Internet, or reading their e-mail.

All this began 15 years ago, when Hi-Mount, a neighborhood school located at the edge of one of Milwaukee's poorest neighborhoods, found itself on a short list of sites for a new French language immersion program. Principal Spencer Korte and a group of teachers proposed that the school instead be given a technology focus. With the help of about $400,000 in local magnet school money over the next several years, Hi-Mount was off and running.

Within five years, educators from across the country were coming to Milwaukee to see for themselves an elementary school with one computer for every two students.

Even more revolutionary at the time was the fact that all those computers were placed in classrooms rather than in central computer labs and were hooked up to Corvus hard drives that eliminated the need for floppy disks.

Significant, too, was the fact that Korte resisted efforts to turn Hi-Mount into a citywide computer specialty school, over time convincing district officials to let him draw his pupils from the neighborhood. "We didn't want to get all the computer nerds — kids and teachers — in one building and create a think tank," he says. Instead, Korte wanted to find out how the mostly minority and mostly poor children living in the immediate area would respond to educational technology.

Six years ago, Hi-Mount negotiated another deal with the district under which the school received a 15 percent boost in its per-pupil budget allotment in return for changes in the school's governance structure that would give more power to teachers and parents. Under the plan, teachers are evaluated by their peers, and the

MILWAUKEE PUBLIC SCHOOLS

Percentage of computers at grade levels	
High school	Not available
Junior high/middle school	Not available
Elementary school	Not available
Location of computers	
Computer laboratories and media centers	50 %
Classrooms	50 %

SOURCE: Milwaukee Public Schools

principal is evaluated by parents and teachers. The money, which has totaled about $400,000 a year, has enabled the school to replace its old Apple IIes with IBM and Hewlett-Packard PCs and to pay for the services of a full-time technology coordinator. It has also hired extra teachers and reduced its class size to 18 students in first grade and 24 students in grades two through five. (The districtwide average is 27 to 30 students to a class at the elementary school level.)

A grant from Ameritech provided for the installation of the school's distance learning lab five years ago and for software and hardware to computerize the school's library. About $65,000 in cash allowed the school to begin a take-home computer project for parents.

Today, Hi-Mount enrolls roughly 600 pupils, 85 percent of whom are minority and 75 percent of whom qualify for free- or reduced-priced lunch. The school's mobility rate is 35 percent compared with a district average of 27 percent. And although its emphasis on technology may be the school's most visible claim to fame, Hi-Mount is becoming almost as well known for its strong commitment to parent involvement.

Parents hold six of 19 seats on the school's community school management team, which manages the school budget, evaluates the principal, sets school policy and hires school staff. The school's parent center offers child-care services, financial and housing assistance, support groups and volunteer opportunities.

The Parent Take-Home Computer Project addresses both technology and parent involvement by allowing any Hi-Mount parent who completes nine hours of computer training at the parent center to borrow an IBM Aptiva computer, printer and modem for six weeks. Parents also learn how to assemble the computer (which comes packed in plastic bins and loaded with some of the same software their children use at school) and set it up at home.

Still, Korte says that given a choice between a school full of computers and a school full of master teachers, he'd take the teachers hands down. "While the early software has been phenomenally improved, the computer still isn't intuitive in way a teacher is at evaluating whether a student is learning or failing to learn," he says. "And if a student is failing to learn, the computer doesn't have the capability to invoke another strategy."

Korte bristles when asked if the technology has boosted standardized test scores. "Every time we hooked up another classroom with Apple IIes, someone asked me that," he says. "I was dumbstruck. There was zero correlation between what kids were doing on those computers and what I knew to be the questions and structure of the test. If the scores go up, that's nice, but I don't think we should expect that of these little boxes."

Instead, Korte sees computers as a means to another end. "This is the way the world does business, and there aren't many jobs worth having that don't rely on technology at their foundation," he says. "I think we have to teach children — all kids, but especially poor kids — these skills as a precursor to their participating in that world.

"Where's your computer? On your desk. It's part of how you do business. Why shouldn't the kids have computers on their desks, too?"

A Systemwide Strategy for Technology

Getting computers on the desks of every teacher and one of every three students in MPS is the job of Bob Nelson, a low-key, affable ex-principal who in 1995 was named to head the district's new Department of Technology, and whose efforts saw the strategic technology plan adopted one year later.

As early as 1968, as a junior high math teacher, Nelson was using symbolic programming language to "teach" an early Olivetti 101 computer to play games. He then taught his students the math behind the games, which enhanced their understanding of the computer.

In 1976, he was tapped to start up the district's first computer specialty program at Washington High School as part of a move to give each of the city's 12 high schools an area of specialization. The idea of setting up a computer specialty school appealed not only to Nelson, but also to a number of the city's business leaders — executives from manufacturing firms such as A. O. Smith and Rexnord as well as Northwestern Mutual Life Insurance and J. C. Penney.

Launched with 144 students, the program's aim was to prepare students for careers in the fledgling computer industry. That emphasis has long since been abandoned in favor of teaching students how to use computers as a research and writing tool, but the early relationships forged between Washington High School and its business partners endured and proved invaluable.

During the 1980s, all the city high schools began offering introductory courses in data processing and elementary computer programming. Then, on their own, elementary and middle schools began applying for grants to buy computers, and the first Apple IIs and Apple IIes started showing up — usually 10 or 12 in a central computer lab, sometimes one or two in a classroom. The movement was piecemeal and entirely driven by the interest of individual principals or teachers.

That was about to change. In 1991, Nelson was named principal of

Washington High School and four years later, chairman of the district's new technology review committee.

One of that committee's early tasks was to prepare a strategic plan that would guide the district's overall technology efforts. The first plan, commissioned from a national consulting firm at a cost of $400,000, was rejected for placing too much emphasis on the business applications of technology while ignoring its potential in the classroom.

"We paid a high price to learn what we learned," says Nelson. Although that plan ultimately helped MPS officials with tasks such as revamping the district's payroll system, it failed to take into account the impact of tools such as the Internet and interactive video on teaching and learning.

The job of reworking the plan fell to Nelson. Enlisting the help of the district's business partners and tapping into research by the Benton Foundation and the North Central Regional Educational Laboratory, he and the other members of the technology review committee refocused the plan on instructional technology.

Nelson estimates that about 25 percent of the overall program outlined in the strategic plan is currently in place. "We've begun moving from the point where we're just talking about technology to the point where we're actually able to use it," he said. The most visible evidence of progress can be found at the city's 12 high schools, where this spring teacher workstations are being installed in every classroom and every classroom is being wired to the Internet.

Nelson anticipates that by December 1999 all 25 district middle schools will be part of the district's wide-area network. Elementary schools will be brought on board over the next two years, at a rate of 50 per year.

Technology from the Principal's Perspective

Making the district's vision for technology a systemwide reality will take more than a handful of believers and the support of the business

TECHNOLOGY AND TITLE I

About four years ago, when Milwaukee's Bell Middle School enrolled enough low-income children to qualify for federal Title I funds for the first time, school officials surveyed staff, parents and students on how to spend the money, which totals between $200,000 and $300,000 a year.

"Overwhelmingly, the answer was technology," says Ann Knackert, Bell's technology coordinator.

Schools have long spent Title I funds, earmarked for boosting the basic skills of poor children, for computers and software. Typically, however, the computers were grouped together in a Title I computer lab and loaded with drill-and-practice software. The only students who could use the computers were those whose family incomes fell below the federal poverty level. New Title I regulations, however, allow schools that qualify for Title I funding to use the money for any student in the school. Even more significant are additional regulations that require schools to focus on critical thinking skills in math and reading rather than on rote learning or memorization.

In response, about 80 of the 144 Milwaukee Public Schools that qualify for Title I funds have turned to integrated learning systems (ILSs), commercial software programs that allow pupils to work at their own level and at their own pace. The programs, which also help teachers track their students' progress, have been customized by MPS and aligned with local and state standards as well as a number of thematic units being used in MPS classrooms.

That means a fourth-grader whose class is studying African-American history, for example, can access computerized reading selections about Rosa Parks. The questions that accompany the selections then zero in on the same type of questions that will show up on the fourth-grade state reading test.

Jim Kurtz, MPS's Title I computer-assisted instruction supervisor, says the new regulations have changed the nature of Title I programs. In the past, students spent 10 minutes on math and 10 minutes on reading a day, generally practicing low-level skills by answering multiple-choice questions. He says the new model involves 30 minutes a day of activities that call on students to answer open-ended questions, draw conclusions, analyze what they have read and solve problems.

As evidence of the new model's effectiveness, Kurtz points to schools that are highly committed to computer-assisted instruction. They include Riley Elementary, where 93 percent of all third-graders tested last year scored at the proficient or advanced levels on the Wisconsin Reading Comprehension Test. That compares with 57 percent of all third-graders tested districtwide, and 71 percent statewide.

Meanwhile, much of Bell's technology plan — including the creation and funding of Knackert's position — has been put in place with Title I money.

Today, Bell has approximately one computer for every three students in the school as well as network and Internet connections in every classroom. It is also one of nine schools taking part in the district's Replicable Schools Program. Under that model, teachers from Bell will help train teachers at other schools in the art of integrating technology into teaching and learning." This never would have happened without our Title I money," Knackert said.

community, though. "You can go out and wire every building, put 12 computers in every classroom and a workstation on each teacher's desk," says Robert Schleck, principal at Burdick. "But the fact is, you can't replicate people. And unless you have large numbers of principals and teachers embracing the idea of technology as a tool that will help improve teaching and learning, all the hardware in the world isn't going to do any good."

Nelson says he was encouraged by the fact that two years ago, when he asked schools to earmark 3 to 4 percent of their annual school budgets for technology, he met with no overt resistance. Today, the challenge is keeping pace with demand.

"People are excited about technology these days, but the longer you have to wait for your school to be wired, the more cynical you become, and the harder it is to sustain interest and support," says Diane Neicheril, principal of Clarke Street Elementary School on Milwaukee's north side.

Neicheril and her staff have succeeded where others have failed. Ninety-eight percent of their students qualify for free- and reduced-price lunch. At the same time, the school's reading scores surpass district averages.

But while there are roughly six computers in each classroom, which are connected to each other via the school's local-area network, Clarke Street isn't yet connected to the district's wide-area network and doesn't have Internet access.

According to Neicheril, the school had originally been scheduled to be hooked up to the network last spring but will now have to wait until next fall.

Typical of the schools that are currently left behind is Townsend Elementary, also located on the city's north side. With 615 students in prekindergarten through fifth grade, Townsend bills itself as a "continuous progress" school that provides individualized instruction in multiage classrooms — a focus some say is perfectly suited to technology. Yet Principal Ken Wald, in his first year as Townsend's principal, admits his school is "pretty limited, technology-wise." The school has one computer lab and between one and four computers in each classroom. Only one computer in the lab is wired to the Internet.

MILWAUKEE PUBLIC SCHOOLS

Total annual technology budget	$37.2 million
Source of technology funding	
Local operating budget	$13 million
Federal funds	$800,000
Grants	$2.5 million
Other (state grants and loans)	$20.9 million

SOURCE: Milwaukee Public Schools

Wald seems of two minds on the subject. On the one hand, he'd like more computers and believes every school in the district should be guaranteed a minimum level of technology. He says some of his teachers believe that more advanced technology would help them more accurately assess their students' achievement levels. Still, if Townsend had more computers, Wald admits he isn't sure exactly how he'd use them or where he'd put them. The school is already crowded, and while parents have been asking for a second computer lab, Wald says he doesn't believe another lab is necessarily the best solution since scheduling classes into the lab is difficult.

Ironing out all these issues is on Wald's list of things to do. But, he concedes, technology is "just one of many issues" demanding his time and energy.

Nelson acknowledges, too, that some schools in the district are even further behind with student-to-computer ratios of perhaps 50:1.

Other principals — including several at the helm of a number of the district's most successful schools — admit that technology isn't their first priority. Tom Hanley, principal of Golda Meir School — a citywide specialty school for the gifted and talented — says he and his staff have chosen to use their discretionary funds to hire several extra teachers instead of investing heavily in technology. "We're not anti-computer, but we really think it's important that kids at this age have a lot of interaction and feedback with people as well as experiences with their physical world," Hanley says. As a result, the school has an industrial arts teacher on the staff who teaches woodworking to every pupil.

Jim Sonnenberg, principal of Westside Academy I and II, has also chosen to earmark local school money for several additional reading teachers rather than more computers. Currently, each of Westside's two sites has a computer lab and between one and five computers in each classroom. One of the two sites is also wired to the district's wide-area network.

"I really think technology is fantastic, but I'm just not convinced that I can replace what those teachers are doing with the computer software that's out there today and expect to get the same results," Sonnenberg says.

A "Critical Mass" of Teachers

Getting support from the district's teachers will also give the district a better chance of replicating its technology success stories. According to Glenn Kleimann, with the Center for Teaching, Learning and Technology in Newton, Mass., school systems often underestimate the complexity involved in getting large numbers of teachers truly technology literate. "You have to go beyond that first wave of teachers — the ones who are already interested," he said. "It's also important to realize that it's one thing to teach them to turn the computer on, boot up, and use a word processor, and another thing entirely to change your classroom so that you're truly integrating technology into the curriculum."

THE HIGH COST OF TECHNOLOGY

Milwaukee's systemwide technology plan is ambitious. But what will it cost to put the plan into action? Once the entire plan is in place in January 2002, the cost will come to an estimated $275 million.

Specifically, the district expects to spend $140 million on hardware and software, $80 million on infrastructure, and $30 million on staff training and curriculum design. Another $10 million will go to support and maintenance and $15 million to programs such as the school management system and new districtwide payroll and accounting programs. Further, annual expenditures for upgrades, maintenance, training and debt service over the long term are estimated at $22 million.

Funding sources for Milwaukee's technology plan include $23.4 million in 1998 E-rate discounts the district received in February and another $20 million in E-rate funds to be requested in 1999, says technology director Bob Nelson. Together with grants from public and private sources and in-kind services, that money will cover about 38 percent of the cost of the plan.

MPS is planning to contribute almost 22 percent, including about $5 million a year for four years from the operations and capital budgets and $10 million a year for four years from individual school budgets.

Another 15 percent of the costs is slated to be covered by long-term financing, with debt service estimated to last about 20 years.

Federal and state money will play roles as well. For example, the Teach Wisconsin initiative, a state law passed in late 1997 to accelerate the use of technology in schools and libraries has provided Milwaukee with $5.4 million, and Nelson expects comparable amounts in each of the next two years. MPS also qualified for $15 million in state wiring loans in 1999.

Despite all of the district's efforts, though, MPS still falls 25 percent short of its $275 million goal. District officials say they are pursuing those funds.

At the same time, studies show that a core of between 15 percent and 20 percent of faculty and students needs to be comfortable with technology before there's sufficient "critical mass" to change the way a school or district operates, says Robert Spielvogel, director of technology at the Education Development Center, a nonprofit research and development organization based in New York City.

With percentages like those, technology "becomes the dominant force and rapidly changes the school culture," says Spielvogel.

Early on, MPS decided to provide free Internet access and e-mail accounts to teachers, install teacher workstations in every school and adopt student management software — decisions that could help the district build critical mass.

Mel Hynek, director of MPS's division of school technology support, says such initiatives helped make teachers more comfortable with technology. "It's like learning to use a microwave — you just have to do it," Hynek says. "And we're giving them opportunities to do it."

Nelson is encouraged by the fact that in the last two years more than 8,000 of the district's 10,000 teachers have completed 12-hour training courses covering the fundamentals of e-mail and Internet access, as well as district policies governing their use. Hynek also says that teacher surveys reveal that 75 percent of the district's teachers are comfortable working with word-processing software, and another 40 percent are comfortable with spreadsheets. More advanced courses, he says, offer training on how to use those skills effectively with students.

Less optimistic is Cheryl Seabrook Ajirotutu, assistant professor of anthropology at the University of Wisconsin at Milwaukee. "In Milwaukee, there are schools such as Hi-Mount, and then there are most of the others, where there is no real sense of how technology fits into the educational program," says Ajirotutu. A cultural anthropologist, Ajirotutu worked with the consulting firm of Coopers and Lybrand to research how technology was being used in MPS during the 1995–96 school year. She is currently working with several city schools to set up a program that will establish e-mail links — and, eventually, collaborative projects — between MPS students and students in Cape Coast, Ghana.

Though she's seen progress in the schools in the last three years, the average school in Milwaukee is still "at the beginning stages in terms of developing curriculum that incorporates technology into all the subject areas," she says.

"Teachers feel so overwhelmed," says Ajirotutu. "Technology is perceived as an add-on . . . , something else you're asking them to do."

Paulette Copeland, president of the Milwaukee Teachers Education Association, talks of the small number of teachers who consider technology a high priority. "Most MPS teachers are not well enough acquainted with what technology has to offer to be clamoring for more computers in their classrooms," says Copeland. "There are too many other things to be worried about, such as keeping children in school, reading, math and test after test after test."

With teachers already staying late to prepare for classes, Copeland says, after-school or evening training sessions aren't always popular. Only three of the 30 staff members at her school have taken advantage of the district's offer of free e-mail because the required training classes are only offered before and after school, she says.

Still, Milwaukee officials are pinning their hopes for the next phase of the district's teacher training initiative on its Replicable Schools Program, a "teachers teaching teachers" model of staff development. The model calls for 61 teachers at nine schools to develop classrooms where technology is integrated into the curriculum. The teachers, who receive ongoing training and support as well as the opportunity to network with each other, will be expected to open up their classrooms, beginning this spring, for observation by teachers who will become a second wave of trainers. The teachers will also use a computer template the district has designed to create a data base of effective lesson plans using technology that will be posted on the MPS Web site.

Ultimately, it's this commitment to training, together with the district's capital investment in technology, that could stand MPS in good stead. "The fact that they're making a massive capital investment in equipment and training in order to incorporate technology into daily instruction, that's a big plus," Cuban says. "It seems they have a vision that says this is about learning, not about technology."

Priscilla Pardini is a freelance writer and editor in Milwaukee who specializes in education issues. Her articles have appeared in *The School Administrator, Middle Ground,* and *Teaching Tolerance* magazines, and in the *Journal of Staff Development* and *Rethinking Schools,* an independent education newspaper. She is author of *The Story of Giving,* a history of Milwaukee's Faye McBeath Foundation. Pardini is a former education reporter for the *Milwaukee Journal.*

⑤ TIPS, RESOURCES AND SOURCES

TIPS

● Many districts have technology plans, but not all have a specific implementation process outlined to put the plan into effect. See if your community or state has such a process, and look at it with a critical eye. Is it realistic? Does it describe what children should know at each grade level, specifically? How will teachers gain technology know-how? And how will the district either reward them, or require them, to use it? Will the budget change appropriately to support these programs? Many districts make pie-in-the-sky promises but don't have the money, foresight or expertise to make them happen.

● Do as much homework as possible before talking to district administrators.

● Challenge people who say their district, school or state doesn't have the money to adopt technology. Some of the poorest areas in the United States have done it. Is resistance a question of funding, or is the problem ignorance, fear, laziness or mismanagement? Does the technology component reflect wider problems in the district?

● Ask whether a technology program boosts academic achievement rather than simply increasing student motivation and interest. Ask, too, whether there's a point when the cost of technology is not worth the results, especially for poor districts. Example: One technology director in Detroit said his after-school computer program wasn't much different from a theatre or arts program in terms of generating excitement, interest and self-confidence among students. A theatre program would be a lot cheaper, though, he said.

● Check into the rate of students' home access, which experts increasingly say is among the most important — and most inequitable — technology issues. Is the school district doing anything to change that access? How do such programs affect students' grades, school involvement, attendance? What about the impact on parents?

● Is the district appropriating resources based on research, or on parental demands, politics or the desire to make impressive headlines? DPS officials and officials at the Edison Project say research shows that technology is most effective at the high school and middle school levels. Yet parents often want their children to have technology access at the lower grades.

● Ask how current a district's or state's vision is for technology. Is its plan based on the most current research? Do its curriculum and its use of technology reflect the research?

● Look at whether technology companies are involved in how schools or districts are developing their technology programs. Are schools considering the long-term maintenance of donated equipment or discounted investments? How will they pay for such costs? Have they spelled out the costs to parents? Will they need to raise taxes or bonds to pay for the technology? In one Detroit charter school, a telecommunications company provided $200,000 in sophisticated hardware that the school rarely used. The catch: The equipment cost $100,000 per year to maintain.

● Most states don't allow communities to use bond money for teacher training and staff development. See if your state does. If it doesn't, check to see if local communities or teacher/technology groups are lobbying to change the law. Such a lobbying effort could show how far along a state's educational community is in its understanding of what's needed to make technology work.

● If you can find people who understand (and possibly have access to) your district's financial records, have them help you analyze how administrators are spending tech-designated money. Are they getting the results such spending warrants? Are there state or federal regulators who are auditing their funding use?

● Check into state and federal records whenever possible to see what they reveal. The forms a school system must file with the Schools and Libraries Division of the Universal Services Administrative Company, the private group handling federal E-rate funds for the Federal Communications Commission, are also useful. (Such forms will document the services the district is seeking, the contractors it is working with and the contract amounts.) If a district won't release the form (Detroit would not provide EWA with a copy of its 471 form), you might consider making a FOIA request.

● Ask for copies of any districtwide or school-by-school hardware inventories that are available. Although officials will tell you such inventories quickly become inaccurate, you can still get a good idea of which schools are technology rich and which are not. Such a measure can help you find schools at both ends of the spectrum, which can help you get a more accurate view of the extent to which technology is being used.

● Attend at least one training session offered for district teachers. When teachers get together, they tend to talk candidly with each other — in this case about the joys and hassles of integrating technology into the classroom. You'll get some good leads and identify teachers who can be contacted later for in-depth interviews.

● In a large district, principals, technology coordinators and librarians may offer the best perspective on how technology implementation is playing out within the schools. These people are in contact with colleagues in similar capacities in other schools in the district and have a good sense of the issues. In Chicago, people in these positions were able not only to talk about how they planned to use technology but were able to recount similar scenarios — and similar constraints — in other schools.

● Technology doesn't happen — or not happen — in a vacuum. To gain a perspective on the issues affecting the system as a whole, attend a district board meeting. In Chicago, the issues of growth and expansion became apparent at such meetings. Witnessing pleas from school representatives for school expansions provided a context for the whole issue of technology implementation and how much attention it could be given by the district in practical terms.

● Don't neglect routine technology meetings. Attending a regional meeting with one extremely gracious teacher trainer led to first-hand information about the concerns of principals and technology coordinators. The questions they directed at representatives of the school board in these sessions were quite revealing.

● Make sure you weigh the value of several different truths and how to go about pursuing them. It was important to mention what the Chicago board of education was doing to address the issue of technology implementation, but this story also had to consider the actual experience of making technology operational in the average school. In the small number of showcase technology schools there was a strong drive on the part of the principal to implement technology and upgrade teaching strategies with technology. These determined schools seemed to thrive early on, even though they didn't have the supports the board would later offer schools. For many schools, the transition to technology was and remains a rugged yet necessary process.

● Ask what role technology plays in the district's or school's academic improvement plan. A number of schools use drill-and-practice programs, tutorials, or integrated learning systems (ILSs), which often focus on specific basic skills. Other schools steer clear of drill and practice and use technology instead to support research, writing, analysis, projects, and critical thinking. The goal: to take advantage of technology's ability to manipulate data, provide ample sources for research and simulate complex ideas or concepts. Recent studies, including a 1998 study from the Educational Testing Service, suggest that there may be little impact on achievement unless students are doing more sophisticated work with technology, such as projects and simulations.

● Don't overlook the importance of teacher training. Technology advocates caution that teacher training must become a major part of a school system's technology investment. Many, in fact, recommend that districts budget at least 30 percent of their technology spending on such training. Further, advocates say, such training must go beyond one-day workshops on word processing and other computer skills and instead begin to address such issues as how to use technology to support the curriculum. Many studies on teacher training, though, show that few teachers have the kind of training that will allow them to incorporate computers creatively into their teaching. A recent study from the National Center for Education Statistics, for example, shows that most teachers (62 percent of those surveyed) had between only one and eight hours of training on technology. Ask what percentage of the school district's technology budget has been earmarked for training teachers to use technology.

● Equity remains a key issue. Ask what steps the school district has taken to ensure that technology resources are distributed equitably in the district and whether the district has a specific plan in place to provide access to schools in historically underserved communities. Watch, too, for wide variations in capacity among schools in a district. Some schools may be adept at finding partnerships and getting grants; others aren't as savvy. Ask what the district is doing to reduce such inequities.

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APPENDIX 1: GAUGING DISTRICTS' TECHNOLOGY PLANS

By Cheryl Lemke, Robert Bortnick, Gilbert Valdez, Randy Knuth, and D. William Quinn

The degree to which a school district's written technology plan indicates successful implementation was one of several questions considered by an expert panel convened by the North Central Regional Educational Laboratory (NCREL) on Dec. 1, 1998, to review technology plans of three of the Midwest's largest urban districts.

The Education Writers Association (EWA) requested that NCREL review the technology plans of four districts — Chicago, Cleveland, Milwaukee and Detroit — to help inform Barriers and Breakthroughs: Technology in Urban Schools. Members of the review panel were Cheryl Lemke, vice president for education technology at the Milken Family Foundation in California; Robert Bortnick, associate superintendent of instruction with Community Consolidated School District #59 in Illinois; Gilbert Valdez, associate director of NCREL and director of the Midwest Consortium for Mathematics and Science Education; Randy Knuth, director of the North Central Regional Technology in Education Consortium; and D. William Quinn, senior program associate at NCREL. Dennis Gooler, associate director of NCREL, facilitated the meeting, and Lawrence Friedman, senior program associate, contributed to the discussion.

As the basis for its findings, the panel used *Technology in America's Schools: Seven Dimensions for Gauging Progress*, developed by the Milken Family Foundation in cooperation with several national organizations, including the American Library Association, the CEO Forum, the National School Boards Association, and the Consortium for School Networking. A complete description of the dimensions can be found on-line at www.milkenexchange.org/policy/pi_preface.html.

The chart on page 51 shows the panel's overall judgment of each plan.*

Considering the degree to which the plan addressed the learner, the learning environment, professional competency, system capacity, community connections, technology capacity and accountability, the panel assigned judgments of whether each dimension was addressed in the plan in a commendable way, in an adequate way, not fully addressed or not addressed. However, in looking at these criteria, the panel believed it was important to recognize that the plans represent the ideal and that the impact on learning can only be developed in conjunction with the existence of infrastructure, access in the classroom and the staff's capacity to be familiar with the basic use of technologies.

In most instances, as illustrated in the chart, the panel reached consensus regarding the degree to which each plan addressed each dimension, noting that less consensus on the Milwaukee plan may have been due to missing information. The appendices, which were referenced but not included with the plan, included fiscal impact, educational priorities and sample classroom lessons. The panel concluded that although the plans for Milwaukee and Detroit show some promise, Cleveland's was the strongest. [Editor's note: Both Detroit and Milwaukee are in the process of revising their technology plans.]

Constraints and Cautions

The panel encountered constraints in its review and offers the following cautions to others involved in a review activity:

- Be aware of how current the plan is. The three plans in this review varied considerably in age, format and level of detail. Cleveland's plan was the most recent, with a date of April 1998. Milwaukee's plan was written in December 1996 and revised in February 1997, and Detroit's plan was written in September of 1995. The panel consulted the Milwaukee Public Schools Web site for additional or more current information, but none was posted. In checking Detroit's Web site, the panel found "A Plan for Implementing Technology," by Robin E. Oden, interim assistant superintendent, and considered it as part of the review process.

- Be mindful of missing information. Milwaukee's plan seemed to have included substantial information as appendices, which were not a part of the plan as furnished nor available on the Web site.

* After receiving a copy of this review, Milwaukee Superintendent Alan S. Brown wrote to EWA about his concerns with the outcome. Brown made the following observations: "(1) NCREL and the readers selected are well qualified to review the plans. (2) Chicago was absent (as noted) from the analysis. (3) The plans submitted for review were developed under varying timetables and for differing purposes and audiences. (4) The plans for both Milwaukee and Detroit are currently being updated. (5) The findings were inconclusive and reasons for this were detailed in the narrative of the report. (6) The chart does not adequately reflect the findings of the reviewers."

Brown also wrote that the district seriously questioned using NCREL's analysis in the report, saying instead, "We believe the work of the writers that have been working extensively in each community and the school districts represented will be compromised with this approach."

DIMENSION	CLEVELAND	DETROIT	MILWAUKEE
1. Learners	Not fully addressed	Not fully addressed	Split: Not fully addressed to adequate
2. Learning Environment	Not fully addressed	Not fully addressed	Split: Not addressed to not fully addressed to adequate
3. Professional Competency	Commendable	Not fully addressed	Split: Not fully addressed to adequate
4. System Capacity	Commendable	Not fully addressed	Not fully addressed
5. Community Connections	Commendable	Adequate	Not fully addressed
6. Technology Capacity	Commendable	Adequate	Adequate
7. Accountability	Commendable	Split: Not addressed to not fully addressed	Not addressed

- Be careful about drawing too many conclusions from a plan. A plan must be put in the context of what's really happening in a district. In this review, personal knowledge of efforts in Milwaukee on the part of one reviewer tempered comments on the written plan itself. Similarly, the Oden piece referenced above (available on the Web site) shed additional light on the Detroit plan.

- Remember that plans represent long-range vision and can't be fairly judged on short-term results. How an organization implements a plan on a short-range basis needs to be flexible and may result in the achievement of some aspects of a vision before others.

Broader Questions

As part of its discussion, the panel also spent time with some broader questions EWA had posed:

Q: *Are there special considerations for technology planning when an urban school district is involved?*

- Compared with suburban districts and even some rural areas, urban school districts have a number of general characteristics that can make technology planning and implementation—along with any other kind of change—challenging. These characteristics include sheer size, frequent change in administration, the influence of big-city politics, younger teachers who often are teaching outside of their majors, greater teacher turnover, difficulty in recruiting, a high degree of diversity (which can pose special challenges to finding consensus), and a lower socioeconomic base (which often results in a lack of community access to technology). Positive signs in large urban technology plans are evidence of union support, an indication that the technology use focuses on more than remediation, recognition of implementation issues at the site level and some notion of how public the plans are.

Q: *How do you determine if time lines and costs are reasonable?*

- Find out who wrote the plan. A good plan will have had involvement of those with a business sense about technology (for example, the cost of hardware, software, training) as well as those who will be responsible for its implementation (such as teachers).

- Pay attention to how the plan is designed. (Example: Are there action steps and benchmarks for implementation?)

- Ask for updates. Plans cover multiple years, but circumstances change, so plans should be revisited and updated at least annually.

- Find out where the funding is coming from. (Example: Is the funding source relatively stable, or is it heavily reliant on referendums or a single funding source such as the E-rate?)

Q: *Can you look at a technology plan and determine whether the plan will be equitable?*

- Look for explicit language indicating that equipment, software and professional development will be available to all schools in a district.

- Look to see if there is any specific order in which schools will have access (example: beginning with schools that are resource poor).

- With any change there are always "early adopters." Look to see if there is an expeditious process to help early adoption.

- Look for explicit language that indicates some means of monitoring equity issues.

- Look for an indication that the plan includes infrastructure, access and the capacity to use technology as part of its definition of equitable—that there is an awareness of different aspects of equity.

Q: *How can you determine whether a plan will make a difference in teaching and learning?*

- Look for explicit reference as to where the district expects to see gains. (Example: A plan might emphasize students' gaining experience with the tools necessary for continued learning rather than traditional test scores.) Standardized tests do not adequately reflect the learning outcomes that are needed or that technology may best address, such as the development of research skills.

- Observe how the technology is integrated into the course of study. (For example, does the curriculum seem to be driving the technology implementation?)

- Does the vision of the plan itself seem to be centered on teaching and learning rather than a management information systems (MIS) focus?

- Is there any explicit discussion about what the technology will mean in classroom practice?

- Look at the budget. Is professional development included as 30 percent or more of the technology budget?

Q: *How do you hold a district accountable for its plan?*

- Find out what the district is trying to accomplish with the plan and what success looks like to school officials.

- Look for benchmarks and milestones in the plan and see how a district argues evidence of completion.

- Find out how — or if — the plan was funded.

- Look beyond the plan itself for indicators of success. For example, the human factor, such as leadership, can translate a weak plan into positive action.

- Look at the composition of the management team, its skills, resources and control over the process.

- Expect technology implementation to alter the nature of teaching and expect results to take time.

APPENDIX 2: SIZING UP TECHNOLOGY INVENTORIES

Getting up-to-date data on a school district's technology base — how many computers it has, where they are located and how old they are — is an important part of any project that tries to gauge how well a district is using technology. But such numbers are difficult to obtain and interpret.

This study draws from two sets of data. First, individual chapters contain information about technology capacity provided by the districts themselves gathered between October 1998 and March 1999. In addition, the charts below, which compare the technology inventories in 16 urban districts, are based on data from the Denver-based Quality Education Data (QED). Collected between October 1996 and May 1997, the data appear in QED's *Technology in Public Schools*, 16th edition (1998). The districts in the comparisons were identified for EWA by the research department at the Council of the Great City Schools.

The Link with Poverty

As the charts show, the four districts in this study had technology bases that were sometimes better — and sometimes worse — than other similarly sized districts. More specifically, the charts suggest:

- Districts with the highest numbers of children eligible for free- and reduced-price lunch had higher ratios of students to computers than districts in which fewer children were eligible. Detroit (70 percent of children eligible for free- and reduced-lunch) had a student-to-computer ratio of 13:1. Houston (60 percent free and reduced lunch) and Dallas (64.3 percent) had ratios of 14:1 and 17:1 respectively. Clark County, Nev., where only 29.9 percent of students are eligible, had a 9:1 ratio.

- Districts in states without significant technology initiatives had higher student-to-computer ratios than districts in states where there have been more ambitious state technology plans and funding. Los Angeles (20:1), Long Beach (18:1) and Fresno (23:1) had the worst student-to-computer ratios of any district in the comparison. Louisville, Ky. (5:1) and Dade County, Fla. (9:1) had the best. An exception: Despite state-level supports for technology in Texas, ratios in Houston and Dallas were also high.

- The districts' computer inventories were likely to include large numbers of outdated machines. According to QED, the entries for "Apple" and "Non-Windows" under the heading "Type of Computer" in the charts below indicate older computer models. In most cases, nearly half of the computers in each city were likely to be older machines— a finding supported in the four districts we studied.

Caveats

Any attempt to pinpoint the size of a district's computer inventory — or to compare that inventory to national, state or local data — can run into problems. Federal efforts to track technology data — such as how schools are using Title I funds to support technology — are just beginning, says Jeff Rodamar of the U.S. Department of Education's Office of Planning and Evaluation. And at the state level, efforts to collect data on technology capacity are fragmentary at best. Among the problems: States use different strategies and different definitions when collecting information, Rodamar says. At the local level, district inventories are often plagued by low response rates to surveys sent to individual schools. In some cases, the inventories consulted for this study included overlapping categories of computers that make it difficult to determine precisely how old — or how large — the inventory actually was. National commercial databases have their strengths and weaknesses as well. QED and the Connecticut-based Market Data Retrieval (MDR) publish annual surveys of technology in the nation's schools, but MDR does not provide district-level data. QED, which does, acknowledges that its figures may underreport the number of computers in schools by as much as 25 percent. The reason for the potential shortfall: Most survey responses are completed in the fall and winter of the school year before a district has made all its technology purchases. Low response rates and old data can also compromise QED's results, some experts say. Cross-checking survey data with anecdotal evidence and local inventories may be necessary. So is keeping the numbers in perspective. As state and federal governments continue to pump dollars into technology, the number of computers in a district can change rapidly, so any inventory represents a snapshot of a district's technology capacity at a specific point in time. The smaller the district, the fewer the computers it needs—and the easier it is to get the most for a relatively small investment, experts caution. Comparing districts of different sizes — 430,000 students vs. 35,000 — can skew results. The following charts, which compare technology capacity in groups of comparable districts, offer such a snapshot.

COMPUTER CAPACITY IN URBAN SCHOOLS: CHICAGO AND COMPARABLE DISTRICTS, 1996–97

	CHICAGO	LOS ANGELES	MIAMI/ DADE COUNTY	PHILADELPHIA
Percentage minority*	89.5	89	86.5	80.2
Percentage free and reduced lunch*	—	72.0	53.5	—
Student-to-computer ratio	16.1	20.1	9.4	14.5
Enrollment	442,960	682,395	355,000	217,393
Number of schools	631	789	325	270
Total number of computers	27,571	34,031	37,689	14,963
TYPE OF COMPUTER				
Apple	9,010	2,816	2,167	8,868
Macintosh	226	5,517	2,718	4,275
Windows	12,280	1,940	65	225
Non-Windows	6,055	2,672	3,662	1,595
Other	763	33,954	34,216	3
NETWORK				
Wide area network (WAN)	Yes	Yes	—	Yes
Server	144	132	92	58
Computers	13,579	2,781	1,926	871
CD-ROMs	1,874	5,275	1,159	1,976

* U.S. Department of Education, National Center for Education Statistics, Common Core of Data, "Public Elementary/Secondary School Universe" survey, 1996–97 and "Public Elementary/Secondary Education Agency Universe" survey, 1996–97.
SOURCE: Quality Education Data, *Technology in Public Schools*, 16th edition

COMPUTER CAPACITY IN URBAN SCHOOLS: DETRIOIT AND COMPARABLE DISTRICTS, 1996–97

	DETROIT	HOUSTON	LAS VEGAS/ CLARK COUNTY	DALLAS
Percentage minority*	94.8	88.9	41.6	89.0
Percentage free and reduced lunch*	69.4	60.0	29.9	64.3
Student-to-computer ratio	13.1	13.7	8.5	17.3
Enrollment	183,447	209,327	200,000	158,433
Number of schools	275	258	220	217
Total number of computers	13,989	15,234	23,539	9,177
TYPE OF COMPUTER				
Apple	5,011	8,465	3,112	1,769
Macintosh	3,224	4,322	10,967	3,749
Windows	762	1,230	6,825	811
Non-Windows	4,963	1,217	2,694	2,848
Other	0	563	732	2,567
NETWORK				
Wide area network (WAN)	Yes	Yes	Yes	Yes
Server	43	180	242	57
Computers	515	897	9,487	1,407
CD-ROMs	1,672	1,655	10,896	1,779

* U.S. Department of Education, National Center for Education Statistics, Common Core of Data. "Public Elementary/Secondary School Universe" survey, 1996–97 and "Public Elementary/Secondary Education Agency Universe" survey, 1996–97.
SOURCE: Quality Education Data, *Technology in Public Schools*, 16th edition

COMPUTER CAPACITY IN URBAN SCHOOLS: CLEVELAND AND COMPARABLE DISTRICTS, 1996–97

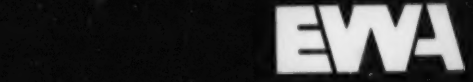
	CLEVELAND	FRESNO	LONG BEACH	FORT WORTH
Percentage minority*	79.4	77.2	80.1	74.1
Percentage free and reduced lunch*	70.9	70.5	65.2	54.5
Students per computer	15.1	22.6	17.7	10.1
Enrollment	76,525	78,953	86,100	73,150
Number of schools	123	96	86	118
Total number of computers	5,065	3,500	4,877	7,273
TYPE OF COMPUTER				
Apple	1,471	272	403	918
Macintosh	1,130	564	1,544	1,973
Windows	339	110	536	666
Non-Windows	2,025	488	450	3,716
Other	324	5,666	5,776	87
NETWORK				
Wide area network (WAN)	Yes	Yes	Yes	Yes
Servers	85	93	36	56
Computers	493	701	770	551
CD-ROMs	389	482	884	831

* U.S. Department of Education, National Center for Education Statistics, Common Core of Data, "Public Elementary/Secondary School Universe" survey, 1996–97 and "Public Elementary/Secondary Education Agency Universe" survey, 1996–97.
SOURCE: Quality Education Data, *Technology in Public Schools*, 16th edition

COMPUTER CAPACITY IN URBAN SCHOOLS: MILWAUKEE AND COMPARABLE DISTRICTS, 1996–97

	MILWAUKEE	MEMPHIS	BALTIMORE	LOUISVILLE
Percentage minority*	77.8	85.6	86.6	33.7
Percentage free and reduced lunch*	65.6	—	62.4	43.0
Students per computer	9.8	9.7	18.2	4.7
Enrollment	98,629	112,979	113,038	96,900
Number of schools	163	169	179	150
Total number of computers	10,015	11,633	6,198	20,676
TYPE OF COMPUTER				
Apple	3,996	2,147	1,783	900
Macintosh	3,767	4,535	1,261	11,850
Windows	534	854	710	4,872
Non-Windows	1,718	3,048	2,444	3,054
Other	173	1,422	140	0
NETWORK				
Wide area network (WAN)	Yes	Yes	Yes	Yes
Servers	191	75	97	78
Computers	3,179	1,600	1,009	1,330
CD-ROMs	2,329	1,685	2,112	1,369

* U.S. Department of Education, National Center for Education Statistics, Common Core of Data, "Public Elementary/Secondary School Universe" survey, 1996–97 and "Public Elementary/Secondary Education Agency Universe" survey, 1996–97.
SOURCE: Quality Education Data, *Technology in Public Schools*, 16th edition



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